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MISCELLANEOUS PUBLICATION No. 316

WASHINGTON, D. C.
OCTOBER, 1938

DESCRIPTIONS OF TYPES OF PRINCIPAL AMERICAN VARIETIES OF SPINACH

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Prepared Jointly by Specialists of the
United States Department of Agriculture
and Cornell University and of the Experiment Stations
of California and Texas

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DESCRIPTIONS OF TYPES OF PRINCIPAL AMERICAN VARIETIES OF SPINACH

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INTRODUCTION

This publication is the fourth of a series dealing with descriptions of types of the principal varieties of vegetables grown in the United States. It is published in response to the needs of seedsmen, produce merchants, vegetable canners, and growers, individually and collectively, for an adequate, accurate, and generally accepted description of varietal characteristics. The sustained interest, generous cooperation, and constructive criticisms of these groups have immeasurably helped the Department and the cooperating State experiment stations in initiating and carrying forward this work. The authors gratefully acknowledge the assistance given them by the above-mentioned agencies and by their colleagues and associates.

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[1] The names of the joint authors who collaborated in the several States are listed according to the alphabetical order of the names of the cooperating institutions as a matter of convenience, since it is not possible to list them in any order of rank or seniority. This publication represents the joint efforts of all the authors, aided by the criticisms and suggestions of the various agencies referred to herein.

OBJECT AND RESULTS OF TYPE STUDIES

As the title suggests, the object of this publication is to describe as accurately and as definitely as possible the form or plan of structure of the most important varieties of spinach (*Spinacia oleracea* L.) grown in the United States at the present time. Insofar as possible, information is also given on the relative importance of varieties for specific purposes and locations, their resistance to disease, and their reaction to different environments.

Since the better plants were selected for description and illustration, these descriptions are somewhat above the average plants of the best commercial stocks available, but they do represent standards quite possible of attainment.

It is hoped that these descriptions may serve as a standard for varietal identification, classification, and nomenclature. Such a catalog of characteristics of the principal varieties should prove of value to all persons interested in the crop, from the seed producer to the vegetable consumer.

Provided with a knowledge of the salient features of each variety, the ultimate user, seedsman, canner, grower, or shipper will be able to determine intelligently the best variety for his particular needs. This intelligent selection should tend to concentrate demand on the most valuable varieties and to reduce the demand for inferior ones, resulting in the gradual elimination of the latter from the trade. The local seed merchant could soon reduce his list of varieties to those best suited to his locality and thereby eliminate a number of unprofitable items from his catalog and his store. Reduction in number of varieties would also enable the seed producer to devote more time and attention to the comparatively few important varieties, with consequent improvement in the quality of commercial stocks.

By making it possible to identify or classify with reference to a standard variety or type, the practice of renaming standard varieties or substituting other varieties with incorrect labeling will be discouraged. If all stocks of a given variety name conform to the standard or type herein described, the buyer can order by name with confidence that the desired type will be secured. It is highly desirable to establish such confidence. The introduction, acceptance, and use of valuable new varieties and strains may be facilitated by indicating their points of difference or superiority over the standard variety they resemble most closely. Plant breeders will also be interested in the ensemble of characters which constitute the principal varieties and may have direction given to their efforts by a study of the importance of different characteristics.

Acceptance of these descriptions as type standards and attainment of the desirable objectives outlined above is entirely dependent upon the voluntary action of everyone concerned. The intense interest exhibited in the work and the splendid spirit of cooperation evidenced on all sides augur well for speedy consummation of the informal cooperation necessary to achieve these objectives.

SUPPLEMENTAL VARIETAL DESCRIPTIONS CONTEMPLATED

Since the initiation of this work a number of new and distinct strains, varieties, or types have been introduced to the trade but have not been sufficiently tested to warrant their acceptance as principal varieties at this time. Attention is called to some of these in the sections entitled "Similar Varieties."

To warrant a new varietal name, the plant introduced should be different in one or more easily recognized or easily determined characters and preferably should contain some characteristic of superiority over existing varieties. Mere difference in a minor character should not be considered sufficient reason for a new name. On the other hand, a new and distinct improvement should be recognized as such by giving the introduction a new name rather than by gradually substituting it under the name of a standard variety, a practice which invariably leads to confusion and distrust. Dark Green Bloomsdale is an example of a stock or strain sufficiently distinct to warrant the new name, although it is still being sold in a great many instances under the old name of Bloomsdale. Long Standing Bloomsdale is another good name for a distinct strain, as it points out its distinctive feature and yet retains the type cognomen. In these names the informative feature is more valuable than brevity.

It should not be inferred that this list of principal varieties meets perfectly all possible requirements of the trade. A careful study of the descriptions will reveal the desirability of many improvements in the present varieties that can and probably will be made in future varieties. Rather than impede progress in the development of new varieties, an unbiased catalog of characters should stimulate the production of better varieties by establishing the standards to which they may be compared and by pointing out the strong and weak points of the present varieties.

The many names listed under "Similar Varieties" indicate the efforts being made by spinach seed producers to produce varieties suited to a wide variety of conditions. With the present interest in better strains of spinach, we may expect that the better of these new strains and varieties will rapidly supplant the strains and varieties important at the present time.

METHOD OF PROCEDURE

The present list of varieties covers between 85 and 95 percent of the acreage of spinach grown in the United States, according to reports submitted by seed growers and dealers at the date the work was started, and it contains all of the important and distinct varieties grown in any section of the country. Seed of the best available stocks of these varieties was secured from domestic and European seed growers through the vegetable research committee of the American Seed Trade Association.

In order to avoid bias for any particular strain during these studies, sources of the material were not divulged; each strain carried only a variety name and number. After the first season's work, one strain was selected on which the records were taken each season. The same seed was used by all collaborators throughout a 3-year period. Observations, measurements, and work outlines were uniform, having been previously agreed upon by the workers in the various locations.

The following descriptions are based upon the results obtained from two crops (1931 and 1932) grown at Ithaca, N. Y.; seven crops extending over 5 years (1931–35) at the Arlington Experimental Farm, Arlington, Va., and at the United States Horticultural Station, Beltsville, Md. (near Washington, D. C.); three crops (1931–33) at Winter Haven, Tex.; and five crops (1931–35) at Davis, Calif.

The manuscript and figures were critically reviewed by all collaborators and also by most of the major American and some of the major European spinach breeders and seed producers. Since the descriptions are based on actual stocks in existence at the time this work was done, the acceptance by this group, best qualified to judge, should be sufficient authority for establishing these as standards or type descriptions for the principal varieties. It is true that not all of the plants of any stock of any variety met the standard herein described, but the percentage was sufficiently high in the better stocks of all varieties to be commercially acceptable. The task of determining the intended type was accordingly relatively easy.

The choice of a name has been influenced by priority, descriptiveness, brevity, and popularity. Juliana has been shortened from the original Princess Juliana, and Viroflay from Monstrous Viroflay. King of Denmark is the most widely accepted name for the type originally introduced as Antvorskov. Dark Green Bloomsdale type is found under a variety of names, and many seedsmen sell this type as Bloomsdale Savoy, although the Dark Green Bloomsdale is a type distinct from the originally introduced Bloomsdale Savoy. Virginia Savoy, Long Standing Bloomsdale, Nobel, Amsterdam Giant, and Hollandia are the originators' names. In cases where names for these varieties now used in seedsmen's catalogs differ from these standard names, it is suggested that the old name be enclosed in parentheses following the standard name in order to acquaint the purchasers with the change in name. After a few years, the listing of the old name may be discontinued.

Synonyms listed under each variety were obtained from Michigan Special Bulletin No. 225, from the Synonym Book of the Ferry-Morse Seed Co., and from trial ground samples submitted for the type-book work and to American seedsmen who have so kindly made their notes available to the authors. The synonym is therefore that of spinach seed growers and dealers. No attempt was made to determine the synonomy of the names listed in the hundreds of retail seedsmen's catalogs and price lists. Where the same name occurs as a synonym under two types it is an indication that in at least one instance different types have been used under the same name.

Every effort was made to provide optimum growth conditions at the different locations by the use of proper fertilization, irrigation, and cultural methods. It is felt that the range in environmental conditions was sufficiently wide, considering the different locations in which the crops were grown, to give good readings on the range of performance of the various varieties, even though extremely unfavorable growth conditions for all varieties were not encountered during the course of the trials.

Habit or shape notes are based on plants that were given sufficient space for uncrowded development. Close spacing of plants results in a very different habit from those illustrated in that the leaves and petioles are more erect. Notes on habit were taken throughout the growth period; and when the shape is different from the illustrated type, the deviations are brought out in the description.

Detailed notes, measurements, and color readings were made at prime marketable stage of maturity, i. e., on plants that had made their maximum vegetative growth. Selection of 25 to 50 of the largest typical plants for the detailed weights, measurements, and ratings was made soon after seedstalk elongation had become visible on a small percentage of typical plants. Plants with visible seedstalks were not used for description.

Plant height and spread were recorded when the plants were turgid, usually in the morning. Spread is the greatest distance between the tips of the largest leaves on opposite sides of the plant. Height was measured from the soil level in the row between the plants to the highest point reached by the plant. In Viroflay, King of Denmark, Hollandia, and Nobel this point was usually at the tips of the younger erect leaves; in the other varieties it was the convex surface of one of the larger leaves.

Leaf (petiole and blade) measurements, ratings, and color readings were made on one of the largest normally developed leaves from each selected plant. Petiole depth is the distance between ventral and dorsal sides (top to bottom) of the petiole; diameter (width) is at a right angle to depth; both measurements were taken midway of the petiole length. In measuring blade length and width, the blades were flattened out so as to give the largest distance between opposite sides or ends of the leaf. In the case of the heavily savoyed varieties and those with curved-under margins, the measurements are larger than the apparent dimensions of the leaves in normal position. Also the ratio of blade length to blade width is smaller than the appearance of the undisturbed leaves would indicate, because a greater proportion of the width than of the length is curved under (pl. 11).

Leaf number includes all leaves 1 inch or more in length.

Color readings were made on the leaves that gave the mass color effect in the field. These were usually the largest leaves or those that made up the greatest visible surface of the plant. The selected leaves were immediately taken to the laboratory and readings made from the Dictionary of Color[2] under light from a north window before the leaves wilted. On account of the high lights from the raised or savoyed regions of the leaves, it was necessary to pinch out and flatten areas from the savoyed varieties before satisfactory readings could be made.

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[2] MAERZ, A. J., and PAUL, M. R. A DICTIONARY OF COLOR. 207 pp., illus. New York. 1930.

IMPORTANT CONSIDERATIONS IN COMPARING SPINACH VARIETIES OR STRAINS WITH TYPE DESCRIPTIONS

Since the greatest value of these descriptions will probably be as a standard by which to judge or compare new or commercial varieties or strains of spinach, great care should be taken to provide proper conditions for valid comparisons. Cognizance should be taken of the variations to be expected, as pointed out in the section on the effect of the environment. Several standard varieties should be included in the test plots to serve as a measure of the variation produced by the particular set of growth conditions encountered.

All strains to be compared should be planted on the same day and given identical cultural practices most likely to lead to the production of a good commercial crop. The plot or field selected should be as uniform in soil type and fertility as possible, and sufficient fertility should be provided for normal growth.

Two or three rows, each 20 to 30 feet long, located in various sections of the plot are likely to give more reliable comparisons than a single longer row.

In order to judge habit, the plants should be given space sufficient that the leaves of adjacent plants do not overlap in the row. Thinning should be done soon after the first true leaves are visible; and since different varieties attain different sizes, it may be necessary to do successive thinnings to prevent crowding.

Varietal differences may be evident very early in the life of the plant and should be noted from time to time, but the main part of the comparisons should be reserved until the plants reach maximum size. Early observations of color and savoying are very valuable in seasons in which these characters may be adversely affected by conditions immediately preceding the elongation of the seedstalk.

Judgment of the long standing quality will obviously require a series of counts at intervals until the latest seeding variety has produced a sizable percentage of "seeders." It is also advisable to note the type of early seeders as they are frequently off-type plant (not typical of the variety in which they occur), the result of mechanical mixture or accidental hybridization.

The type of off-type plants should be noted as one of the characteristics of the strain being studied. The percentage of typical "extreme male" plants, which characteristically shoot to seed earlier than other sexual types, should be noted. If the material is badly mixed or extremely variable, an attempt at a characterization of it is obviously unwise. At least 25 to 50 plants should be used as a basis for the comparison or characterization.

As mentioned above, color readings should be made several times during the growing season in order to have a complete comparison of color differences. Field observations should be made with the sun at the observer's back on a quiet day and with the leaves free of soil, dew, or moisture on the upper surfaces. Strong winds expose the lower surfaces of the leaves, which are lighter green than the upper surface, thus giving an impression of a lighter green than is normal. In making field comparisons of color, it is advisable to frequently recheck by using leaves of one variety as a standard for comparison in all sections of the field or plot.

After classification into general color groups in the field, large normally developed leaves that produce the mass color effect of a variety should be selected for comparison with the color plate. As a protection against marring or soiling the color plate, a piece of neutral gray paper or cardboard should be used as a background or mask. A hole large enough to accommodate the major portion of the smaller color rectangles on the plate should then be cut in the background paper. The leaf to be compared may then be wiped clean and dry and laid adjacent to the hole in the background. By moving the background cardboard about over the colored plate, comparisons may be rapidly made and the leaf color matched with a color on the plate. The leaves should be flattened as much as possible so that both leaf and color plate may be in the same plane. Sky light from a north window striking the surfaces to be compared at an angle of 40° to 50° has been found to give the best results, although it is sometimes necessary to vary the angle slightly in order to avoid high lights on heavily savoyed surfaces.

The same procedure may be followed in the use of any of the printed or painted color-standard books, except that the area of the opening in the mask or background should be slightly smaller than one of the colored rectangles of the standard. The numerical designations of color values used in this publication are those used in A Dictionary of Color.[3]

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[3] Maerz, A. J., and Paul, M. R. See footnote 2.

GENERAL NOTES ON ENVIRONMENTAL CONDITIONS

In order to supply general information on the environmental conditions under which the various crops of spinach developed the characters described, data are presented [4] on the average daily mean temperatures for 5-day intervals (table 1), average mean temperature from the date of seedling emergence from the soil to the date of first seedstalks (table 2), amount and distribution of rainfall (table 3), and the number of hours of possible sunlight per day during the growing season (table 4). It will be noticed that the 5-day intervals start from date of seedling emergence, and, therefore, cover different calendar periods for the different crops.

The environmental conditions for each year and location may be briefly summarized as follows: Moisture was abundant and temperatures favorable for rapid growth at Ithaca, N. Y., in 1931 and 1932, and an excellent growth was produced in spite of the long days which favored early seedstalk formation. At Arlington Farm, Arlington, Va., during the 1931 spinach season there was an abundance of moisture at all times, the alternating periods of cool and warm temperatures were very conducive to continued vegetative growth, and large size was attained for that locality. In spite of earlier planting in 1932 and the use of overhead irrigation during a 14-day dry period in April, early growth of the crop was slow. Abundant rainfall in May, however, speeded up growth and good size was attained before high temperatures of mid-May forced seedstalks in all varieties. High temperatures and long days encountered early in the life of the 1933 crop, because of late planting, resulted in the early formation of seedstalks, and plant size compared to that of 1931 and 1932 was consequently much reduced. The 1934 season and growth were very similar to those of 1931.

The 1931 growing season at Davis, Calif., started off satisfactorily, but an unusually dry later part of the season resulted in small plants. An unusually cool and dry April and May in 1932 delayed the maturity and resulted in relatively small size. Although planting was late in 1933, the cold spring delayed the formation of seedstalks until the plants had attained large size.

The Winter Haven, Tex., plantings were irrigated by the furrow method whenever it seemed advisable. The 1931 crop was planted late for that section and encountered warm weather rather early in its life, which caused it to shoot to seed before large size had been attained. The 1932 crop was planted late, but the fluctuating temperatures delayed seedstalk formation until fair size was reached. In 1933 the crop was planted in October and grew for almost 2 months under conditions of decreasing day length and temperature that prevented seedstalk formation. As a result, very large size was ultimately attained.

INFLUENCE OF ENVIRONMENT ON GERMINATION

In this publication the terms "germination" and "seedling emergence" are used synonymously and refer to the dates at which the majority of seedlings had emerged from the soil and unfolded their cotyledons. There was no varietal difference in the rate of germination at any of the locations. There were, however, marked differences in the time required for germination of all varieties at different locations and at the same location in different years. In general, high average air temperatures resulted in faster germination than low air temperatures (table 5), and very similar average air temperatures resulted in approximately the same rate of germination at all locations. Heavy or frequent rainfall during the germination period usually delayed seedling emergence. (Compare Davis, December 12, 1931, with January 1933 planting; Ithaca 1931 with 1932, in table 5.)

INFLUENCE OF ENVIRONMENT ON PLANT HABIT

Habit refers to the position of the petioles and blades with reference to the soil surface. The ratio of plant width (spread) to height gives a fairly accurate index of plant habit, and the data in table 6 indicate the extreme flattening effect of the uniformly high temperatures of the 1931 season in Texas. The effect was most pronounced on the flat-leaved varieties but affected all varieties in the same manner (pls. 2, 6, 12, 16, 22, and 26). Cool temperatures, or cool nights at least, tend to make the plants more erect in habit. In a fall-grown crop of the normally erect growing varieties, the tendency is for the plants to become flatter as successive frosts weaken the older petioles. New leaves which form in the spring on the wintered-over plants assume the characteristically erect position.

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[4] See Appendix.

INFLUENCE OF ENVIRONMENT ON SAVOYING

Generally speaking, low temperatures, especially at night (even though day temperatures may be moderate) result in the development of intense savoying in the varieties possessing this characteristic and a crumpling or pebbling of the base of the blades of the smooth-leaved varieties. High temperatures, and especially uniformly high temperatures, result in a decrease in the amount of savoying or crumpling of the blades. The amount of savoying has been observed to change with a change in air temperature of but 4 or 5 days' duration.

INFLUENCE OF ENVIRONMENT ON COLOR

With a high level of balanced soil fertility, such as was provided in these tests, low temperatures usually result in the production of a heavy bloom and good green color. With medium or favorable temperatures for rapid growth, the amount of bloom is reduced and the plants appear lighter green. With excessively high temperatures for an extended period the edges of the older leaves turn yellow, followed by others of decreasing age toward the center of the plant. If high temperatures persist long enough the entire leaf may become yellow and the plant may die, usually as a result of an attack by some disease which kills the root or attacks the plant at the ground line.

In spite of the varied environmental conditions under which the different crops were grown, the varieties were classified into the same general color groups almost without exception. Minor differences within the group were not uncommon between tests, but the differences were not great enough nor consistent enough to warrant placing a variety in different color groups in different tests.

INFLUENCE OF ENVIRONMENT ON SEEDSTALK FORMATION

The date of appearance of seedstalks on 5 to 10 percent of the typical plants in the variety was recorded as the date of first seedstalks. Plants were counted as "seeders" as soon as elongation had proceeded to the point where it was possible to distinguish nodes on the central axis, i. e., the appearance of space between the bases of adjacent petioles.

The number of days between seedling emergence and first seedstalks is quite variable for any given variety when all of the crops grown are considered (table 7). The order of shooting to seed among the different varieties, however, is surprisingly constant. An explanation of the variable results obtained with the same variety and strain under different conditions rests upon a knowledge of the effect of each of the components of the environment in different combinations and during different stages of the plant's development.

Varieties differ in their response to the important factors of temperature and length of day as evidenced by the difference in number of days required for seedstalks to appear (table 4). They also differ in the minimum length of day required for seedstalk formation. In general, at day lengths beyond the minimum, an increase in temperature results in earlier seedstalks; and at ordinary growing-season temperatures, an increase in day length results in the earlier appearance of seedstalks. Older plants are more sensitive to long days and high temperatures, which are favorable to seedstalk formation and elongation, then are younger plants. Plants crowded in the row will produce seedstalks sooner than those given plenty of space in which to develop.

INFLUENCE OF ENVIRONMENT ON PLANT SIZE

With such widely divergent environmental conditions and lengths of growing period as were encountered in this study, one would expect to find the large differences in the components of plant size (weight, spread, and height) shown in tables 8, 9, and 10. Harvests of plants of marketable size from the same variety on successive dates and prior to shooting to seed show that with increase in age there is a marked increase in plant weight, leaf number, and blade size with little change in plant height, spread, or petiole length.

Assuming an abundant supply of moisture and fertility, maximum plant weight (yield) is attained under conditions of short-day length and moderate to warm temperatures, or when the relation between day length and temperature is such as to deter the elongation of the seedstalks and yet produce the fastest growth of leaves (Texas and California, 1933). The optimum relation between these two factors of the environment differs for the several varieties with respect to both plant weight and plant spread or width. Plant height seems to be most influenced by temperature; uniformly high temperatures resulting in very prostrate plants (Texas, 1931), and low growing temperatures or at least cool night temperatures tend to produce taller or more erect plants (California, 1933). Repeated freezing of fall-grown plants, however, results in a flattening down of the leaves.

INFLUENCE OF ENVIRONMENT ON LEAF NUMBER

The effect of different environmental complexes on the rate of development and number of leaves is quite marked (table 11). In general, the number of leaves is correlated with the length of growing period, but there are exceptions (Ithaca, 1931 and 1932; Davis, 1931 and 1932), which indicate that temperature and nutritional conditions at critical periods may be equally important. Leaf production per day of growing period generally appears to be highest under long-day and relatively high temperature conditions (Arlington and Davis). The 1933 results from Winter Haven, however, suggest that decreasing or short length of day and average daily temperatures between 50° and 60° F. were most efficient in rate of leaf initiation.

INFLUENCE OF ENVIRONMENT ON BLADE LENGTH AND WIDTH

Blade length and width (tables 12 and 13) depend (1) upon the length of growing period and (2) upon the environmental complex during the growth period. Uniform, moderate to high temperatures and long days are more conducive to rapid growth than low temperatures and short days, but the ultimate size of the blade depends upon both the rate of growth and the length of the growth period. High temperatures may shorten the total growth period so much that ultimate leaf size is smaller than under certain lower temperatures. There is some indication that the smooth-leaved varieties tend to produce relatively longer leaves under short days and low temperatures than the savoy-leaved varieties.

INFLUENCE OF ENVIRONMENT ON BLADE SHAPE

With respect to the relative shape of blade, i. e., the ratio of total blade length to total blade width (table 14), there was very little significant difference between the different locations or between the different years at the same location except at Arlington where the 1931 and 1933 leaves were more slender than those of 1932 or those at any of the other locations. Since the conditions of 1931 and of 1933 at Arlington were so different from those of 1932 it is difficult to determine the factors mainly responsible for this change in relative shape.

With respect to general visible outline of the leaf, it was observed that cool weather, or at least cool nights, resulted in the curling down or under of the tip, edges, and basal lobes of the blades, thus obscuring the true halberd shape of the savoyed varieties and King of Denmark. Under such conditions the blades appeared oval or elliptical in outline.

INFLUENCE OF ENVIRONMENT ON RATIO OF BLADE LENGTH TO PETIOLE LENGTH

The relative amount of petiole is a factor of commercial importance, especially to the canner of spinach. The ratio of blade length to petiole length is presented in table 15. Considering all the data, conditions that resulted in the largest size of leaf also produced the longest blades both in absolute length and relative to petiole length, and conversely, the shortest petioles. This would seem to indicate that the major portion of the growth in petiole length was made relatively early in the life of the plant and that, when conditions favorable for continued or rapid growth occurred,growth in blade length was more rapid than growth in petiole length.

INFLUENCE OF ENVIRONMENT ON PETIOLE SIZE AND SHAPE

Data on petiole length, petiole diameter, and the ratio of petiole length to petiole diameter disclose no general significant correlations with any specific set of environmental conditions, except that conditions that produce the largest plants also produce in general the longest and thickest petioles (tables 16, 17, and 18).

VARIETAL REACTION TO HEAT AND COLD

It was observed that high temperatures caused a yellowing and the subsequent death of the lower leaves. A shortage of soil moisture accelerated the process; but temperatures above 100° F. have been observed to produce yellowing of the lower leaves, even in soil apparently well supplied with moisture. Hollandia, Nobel, and Viroflay were more quickly affected to a noticeable degree than the other varieties, probably because it required a smaller change in their color to produce a shade of green that would be objectionable on the market. In Texas the Virginia Savoy variety seemed to be least affected by high temperatures.

Temperatures low enough to cause damage to spinach were encountered only in the growing season for the 1932 fall-grown crop at Arlington, and for the 1932–33 crop at Winter Haven. In the early winter of 1932 at Arlington, temperatures of 20° F. did no apparent damage; but when the temperature dropped to 9° and minima below 29° occurred for 9 consecutive days during mid-December, extensive death of blade tissue followed. None of the varieties escaped damage, but contrary to statements in some seed catalogs, the prickly-seeded Hollandia was more severely damaged than the other large flat-leaved varieties in that the killed areas involved a greater proportion of the blade surface than in the savoyed varieties. None of the varieties had all of the plants killed; and because of the presence of disease, it was impossible to determine the relative winter hardiness of the varieties.

In February 1933 all of the principal varieties in mature, vigorous vegetative condition were subjected to minimum temperatures of 18°, 21°, 34°, 26°, and 32° F. on successive days at Winter Haven. This cold spell resulted in the death of portions of the blade and the splitting open and flattening out of the epidermis of the petioles. The extent of the damage was most severe on the Hollandia, Juliana, and Long Standing Bloomsdale varieties and least severe on Virginia Savoy, Dark Green Bloomsdale, and King of Denmark, with Viroflay and Nobel intermediate. None of the disease-free plants were killed by these temperatures.

VARIETAL REACTION TO DISEASE

Counts of diseased plants were made on crops grown during the fall and winter of 1932 and 1933 at Arlington, Ithaca, and Winter Haven (table 19). No attempt was made to determine the identity of the possible virus diseases that might have been present. It seems probable from the relative freedom from disease of Virginia Savoy at Arlington and Ithaca, that the principal trouble was the well-known spinach "blight," also termed "mosaic" or "yellows," although proximity to other vegetables makes it entirely possible that cucumber, celery, or beet mosaic, or possibly aster yellows may have been present to a slight extent. Virginia Savoy and Old Dominion showed marked resistance to the viruses present.

At Winter Haven separate counts were made of plants affected by fusarium wilt and of those whose symptoms agreed more or less closely with the published symptoms for spinach mosaic or yellows. The fact that Virginia Savoy had as many affected plants of this type as the other savoyed varieties cast doubt upon the diagnosis at that time. In the winter of 1935–36 it was definitely established that curly top was present in the district in epidemic form, and it seems likely that it or some other virus disease may have been the cause of the stunting and yellowing of the plants, recorded in table 19 as virus diseases. While none of the varieties was immune to this trouble, the savoyed were less affected than the smooth-leaved varieties. None of the varieties indicated any resistance to fusarium wilt at Winter Haven or to *Pythium butleri* Subr. at Arlington.

DISTINGUISHING VARIETAL CHARACTERISTICS

The principal characteristics of the varieties of spinach described in this publication are given in table 1.

TABLE 1.—*Distinguishing characteristics of 10 varieties of spinach*

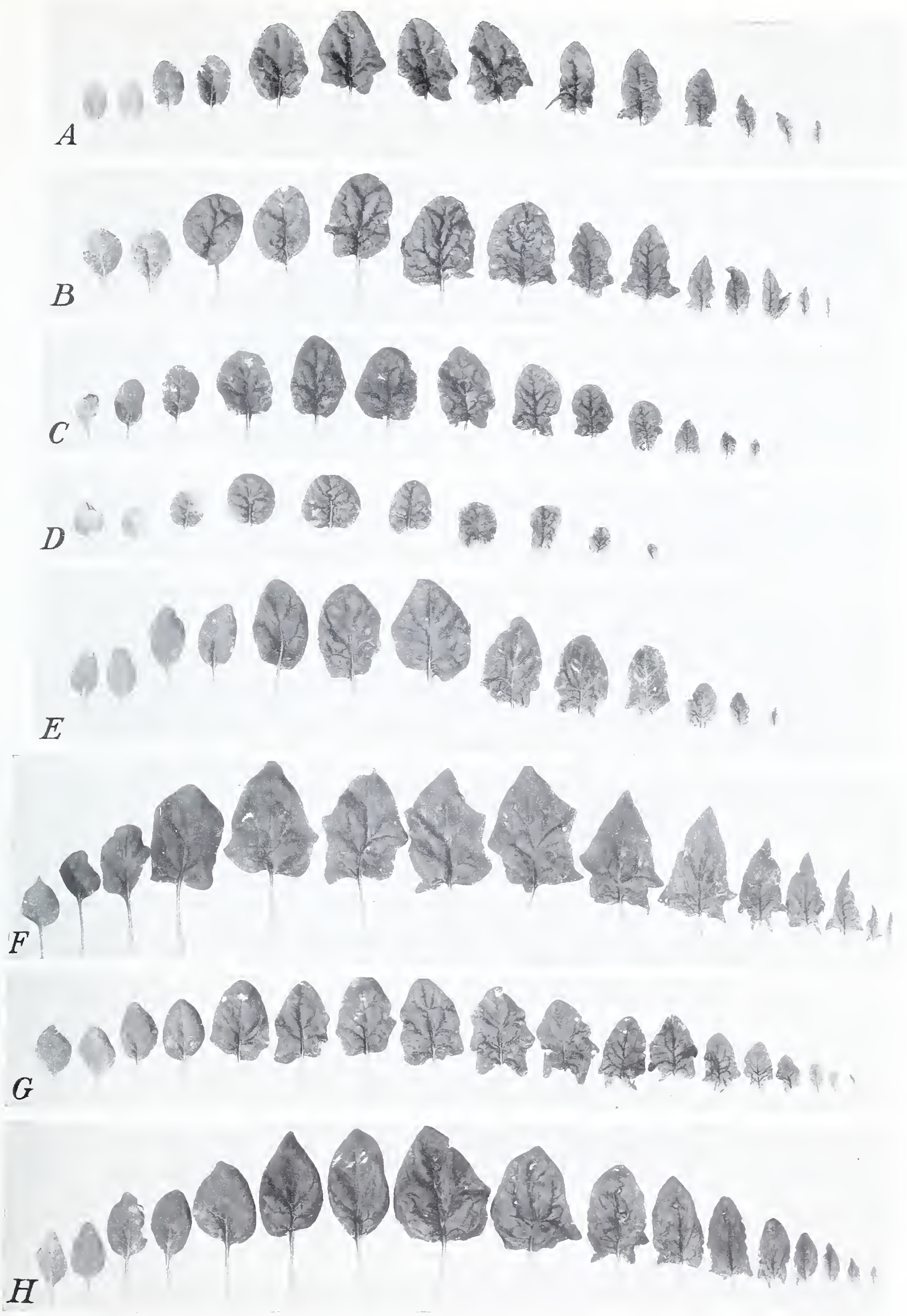
Item	Virginia Savoy	Old Dominion	Dark Green Bloomsdale	Long Standing Bloomsdale	Juliana
Chief use	Market	Market	Market and canning	Home and market	Home.
Growth rate	Very fast	Very fast	Fast	Medium	Very slow.
"Seeder" rate	do	Fast	do	do	Slow.
Plant size	Small to medium	Medium	Small to medium	do	Small.
Plant habit	Erect	Medium erect	Erect	Medium erect	Inverted bowl.
Leaf size	Medium	Medium	Medium	Medium	Small.
Leaves number	8–29	12–30	12–30	13–29	12–24.
Leaf color	Dark green	Dark green	Dark green	Dark green	Blue green.
Leaf surface	Savoyed	Medium savoyed	Savoyed	Savoyed	Savoyed.
Leaf shape	Oval	Oval-halberd	Oval	Oval	Oval-round.
Leaf tip	Round-pointed	Round-pointed	Round-pointed to round	Round-pointed to round	Round.
Leaf base	Slightly cordate	Cordate	Cordate	Cordate	Cordate.
Leaf edge	Curled down	Flat or curled down	Curled down	Curled down	Curled down.
Petiole length	Medium to long	Medium to long	Medium	Medium	Short.
Petiole thickness	Medium to thick	Medium to thick	Medium to thick	Medium to thick	Medium.
Seed character	Smooth	Smooth	Smooth	Smooth	Smooth.

Item	King of Denmark	Viroflay	Nobel	Hollandia	Amsterdam Giant
Chief use	Home and canning	Canning and market	Home and market	Canning and market	Canning and market.
Growth rate	Slow	Fast	Fast	Fast	Medium.
"Seeder" rate	do	do	Slow	do	Do.
Plant size	Large	Medium to large	Large	Large	Medium to large.
Plant habit	Flat	Flat	Flat	Erect spreading	Flat spreading.
Leaf size	Large	Medium to large	Very large	Very large	Medium to large.
Leaves number	11–41	15–38	16–38	12–31	15–33.
Leaf color	Blue green	Medium green	Medium green	Light green	Dark green.
Leaf surface	Smooth	Smooth	Smooth	Smooth	Smooth.
Leaf shape	Oval-halberd	Halberd	Broad-halberd	Broad-halberd	Oval-halberd.
Leaf tip	Pointed to slightly round	Pointed	Round-pointed	Pointed	Round-pointed.
Leaf base	Tapered to cordate	Square to cordate	Square to slightly cordate	Square to slightly cordate	Square to slightly cordate.
Leaf edge	Flat or curled down	Flat	Flat	Flat	Flat or curled down.
Petiole length	Long	Long	Medium to long	Long	Medium to long.
Petiole thickness	Medium to thick	Medium to thick	Thick	Thick	Thick.
Seed character	Smooth	Smooth	Smooth	Prickly	Prickly.

CLASSIFICATION OF PRINCIPAL AMERICAN VARIETIES OF SPINACH

- A. Leaves savoyed.
  - B. Leaves heavily savoyed.
    - C. Plants late seeding.
      - D. Leaves blue-green Juliana.
      - D. D. Leaves dark green Long Standing Bloomsdale.
    - C. C. Plants not late seeding.
      - D. Plants very early seeding Virginia Savoy.
      - D. D. Plants medium-early seeding. Dark Green Bloomsdale.
  - B. B. Leaves medium savoyed Old Dominion.
- A. A. Leaves not savoyed (or slightly savoyed in cool weather).
  - B. Plants early seeding.
    - C. Seeds prickly Hollandia.
    - C. C. Seeds not prickly Viroflay.
  - B. B. Plants not early seeding.
    - C. Seeds prickly Amsterdam Giant.
    - C. C. Seeds not prickly.
      - D. Leaves blue-green King of Denmark.
      - D. D. Leaves medium green Nobel.

LEAVES OF SPINACH VARIETIES



Range in size, shape, and number of leaves on the same date of a typical spinach plant grown in Virginia of (A) *Virginia Savoy,* (B) *Dark Green Bloomsdale,* (C) *Long Standing Bloomsdale,* (D) *Juliana,* (E) *King of Denmark,* (F) *Viroflay,* (G) *Nobel, and* (H) *Hollandia.* × 1/6. *Oldest leaf on left; youngest on right.*

VIRGINIA SAVOY

BRIEF CHARACTERIZATION

Very hardy to frost and resistant to blight (mosaic) and, therefore, recommended for planting in the fall or early winter where blight may be present. Grown for home use, market garden, or shipping. Not recommended for spring sowing because of its very early production of seedstalks.

Fast growing and very quick to shoot to seed in the spring. Plants small to medium in size with erect-growing, medium to long, rather thick petioles which hold well above the soil the dark-green, heavily savoyed, oval-shaped, curved blades.

ADAPTABILITY AND USE

Virginia Savoy is widely used in sections where wintering over is possible and where spinach mosaic or blight is present. It is the most winter-hardy variety and grows rapidly during relatively warm periods in winter. It is also the earliest seeding variety described and for that reason is not recommended for planting in the spring where air temperatures and length of day increase rapidly. Old Dominion, a relatively new mosaic-resistant variety of the same type, but later seeding, is supplanting it for the latest plantings to be wintered over. In common with other savoyed types, Virginia Savoy is a good shipper because it does not pack too tightly in the container, and therefore does not heat readily, and because it retains its dark-green color well in transit.

SEASON

Very fast growing, reaching 10 cm (4 inches) in diameter in 15 to 30 days from date of germination when grown in the North as a spring-sown crop, but requiring from 55 to 90 days to reach the same size when grown as a winter-sown crop in Texas and California. Very quick to shoot to seed, seedstalks usually appearing in 30 to 45 days from date of germination in the spring-sown crop in northern sections. As a winter-sown crop in the West and Southwest, the seedstalks appear in 60 to 90 days, depending upon date of sowing and weather conditions (p. 6). The fastest growth and earliest seedstalks are produced under conditions of abundant moisture and fertility, high temperatures, and long days.

PLANT [5]

(Pls. 1, *A*; 2; and 3)

Small to medium size, usually 50 to 75 g (1¾ to 2½ ounces) average weight as a spring-sown crop in the North and East and 60 to 120 g (2⅛ to 4¼ ounces) as a winter crop in California and Texas; under very favorable conditions has attained an average weight of 142 g (5 ounces), and under very unfavorable conditions as small as 7 g (one-fourth ounce) per plant at date of appearance of first seedstalks; average height, 10 to 15 cm (4 to 6 inches); average spread, 25 to 33 cm (10 to 13 inches), which is approximately 1.8 to 2.4 times the height. Typically erect growing (vase or palm-tree shaped), but under uniformly high temperatures of late winter and early spring in Texas becomes flattened (inverted saucer) in shape (pl. 2). Practically no axillary growth except in the winter-grown crops. The average number of leaves over 1 inch in length is usually 13 to 18, but under extreme conditions as few as 8 or as many as 29.

PETIOLE

Light green (20 J 7),[6] underground portion of petioles and taproot pale purplish pink (2 D 4) on 80 to 90 percent of plants, white or light cream on others; medium to long, typically 6 to 10 cm (2⅜ to 4 inches) long, 0.5 to 0.7 cm (three-sixteenths to nine thirty-seconds inch) wide (in diameter), and 11 to 16 times as long as wide; under extremes of environment the average petiole length ranging from 4.1 to 10.5 cm (1½ to 4¼ inches); width from 0.30 to 1.01 cm (one-eighth to three-eighths inch) and relative length of petiole from 10.4 to 18.3 times the width; straight to slightly curved; almost round in cross section with a range in ratio of depth to width of 0.92 to 1.14; held at an angle of 30° to 80° with the horizontal thus holding most of the blades above the soil.

BLADES

Glistening dark green (23 L 6) on upper surface, glistening medium green on lower surface (22 K 6);

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[5] For details of variation in plant characters induced by environment see tables in Appendix and discussion on p. 5.

[6] References are to plate, column, and row: e. g., 20 J 7 refers to plate 20, column J, row 7, in A Dictionary of Color.

heavily savoyed over entire surface except when grown under high temperatures when the margins become almost flat and smooth; veins inconspicuous on well-savoyed leaves because of depressed nature; medium size, typically 7 to 11 cm (2¾ to 4¼ inches) wide, 10 to 14 cm (4 to 5½ inches) long, 1.08 to 1.20 times as long as wide, and 1.25 to 1.65 times as long as the petiole; under extremes of environment average width ranging from 4.9 to 12.2 cm (1⅞ to 4¾ inches), length from 7.3 to 15.2 cm (2⅞ to 6 inches), ratio of length to width ranging from 1.02 to 1.34 and of blade length to petiole length from 1.14 to 1.90. General shape broad ovate but obscured by curling under of the edges and the one pair of blunt-pointed basal lobes, which make the blades appear oval; tip round-pointed to round; base slightly cordate; viewed from side and end, the blade is convex (reclined) and margin of leaf curls downward, except under continuous relatively high temperatures when the leaf margins are almost flat.

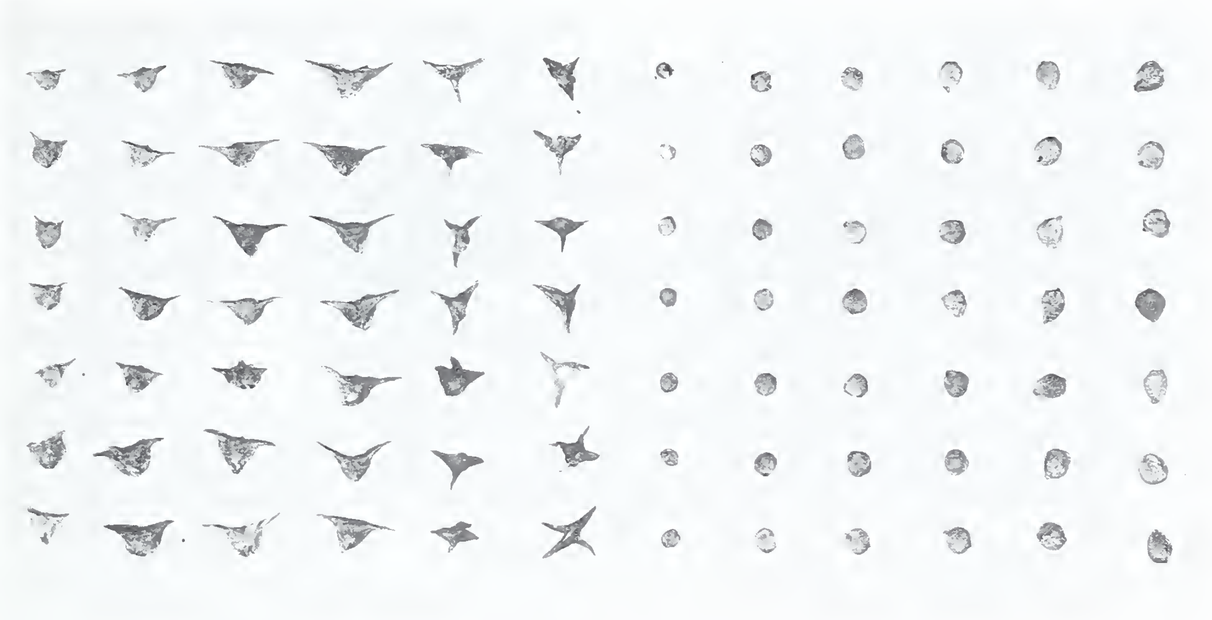


FIGURE 1.—Range, size, and shape of smooth seed (right) and prickly seed (left) of spinach. Natural size.

SEED

Medium size, round, smooth (fig. 1).

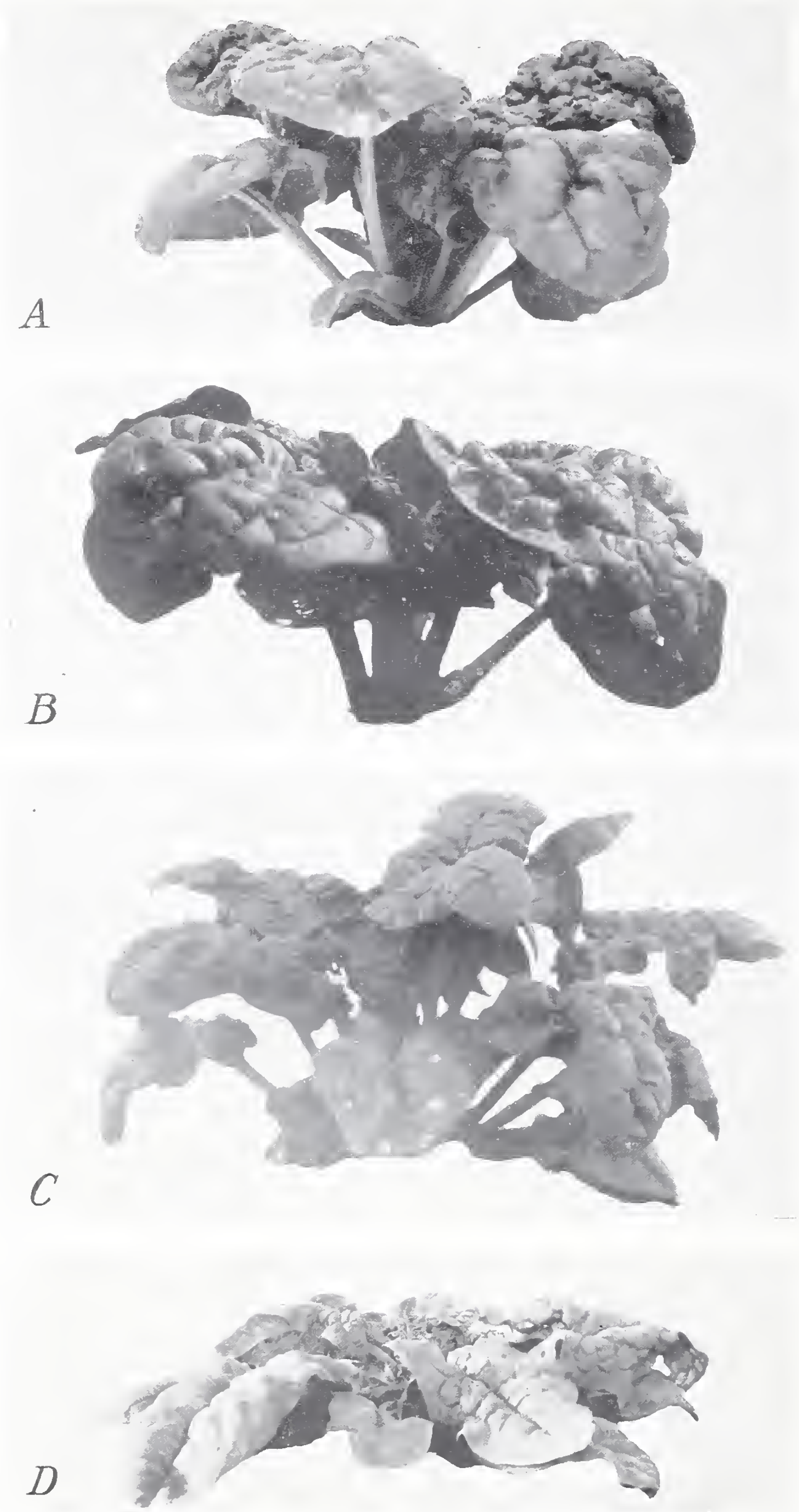
SYNONYMS

Blight Resistant Savoy Leaved; Bloomsdale Blight Resistant Savoy; Bloomsdale Resistant; Bloomsdale Savoy Virginia Blight Resistant; Savoy Leaved Bloomsdale Blight Resisting; Virginia Blight Resistant Savoy-Virginia Savoy (Blight Proof).

HISTORY

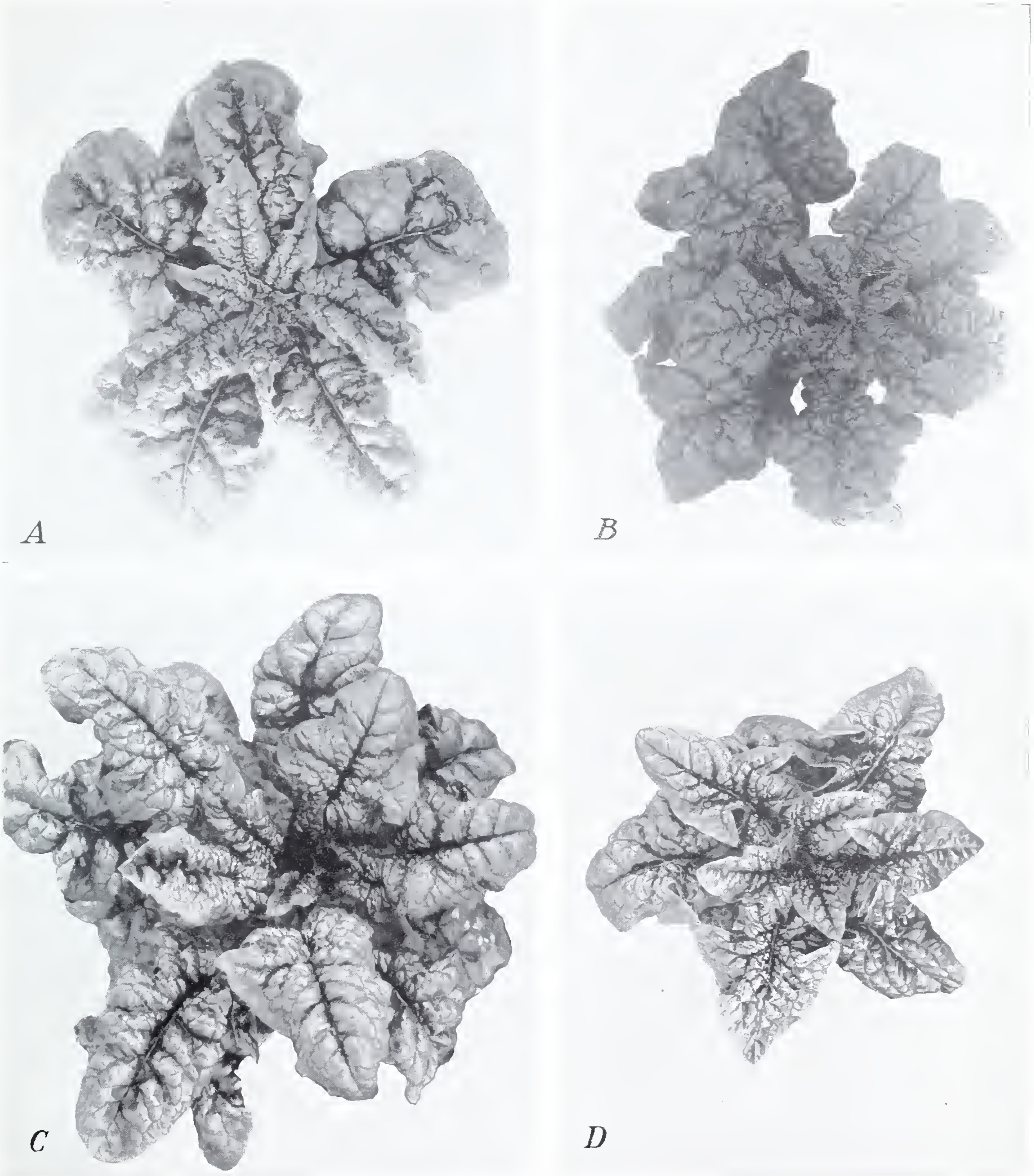
First introduced to the seed trade in 1921 by the Virginia Truck Experiment Station, Norfolk, Va., as a mosaic-resistant variety. Subsequent releases of improved stocks have been made from time to time. This variety resulted from hybridization between a commercially worthless Manchurian form and Bloomsdale Savoy, Long Standing, Flanders, and Round Thick Leaf Winter varieties, followed by rigorous selection. The Manchurian parent furnished the resistance to the mosaic disease.

VIRGINIA SAVOY SPINACH



Typical plants of Virginia Savoy spinach grown in (A) *Virginia in 1931,* (B) *California in 1931,* (C) *Texas in 1932, and* (D) *Texas in 1931.* × 1/3. *Note flat habit of Texas 1931 plant.*

VIRGINIA SAVOY SPINACH



Typical plants of Virginia Savoy spinach grown in (A) *Virginia in 1932,* (B) *California in 1932,* (C) *Texas in 1932, and* (D) *Texas in 1931.* × $^1/_3$.

OLD DOMINION[7]

BRIEF CHARACTERIZATION

Very hardy to frost and resistant to blight (mosaic) and, therefore, recommended for planting in the late fall or early winter for spring harvest in sections where blight is present and wintering over is possible. Grown for home use, market garden, or shipping.

Fast growing and quick to shoot to seed in the spring. Plants medium in size with slightly spreading, medium to long, rather thick petioles with dark-green, moderately savoyed, oval to halberd-shaped blades.

ADAPTABILITY AND USE

A succession variety to Virginia Savoy, as it shoots to seed later in the spring, thereby increasing the length of the harvest period. It is reported to resume growth in the early spring sooner than Virginia Savoy and is, therefore, larger and a better yielder. Used almost exclusively for the wintered-over spring crop around Norfolk, Va., and for the same purposes as Virginia Savoy.

SEASON

As fast growing as Virginia Savoy but from 3 to 14 days later seeding.

PLANT

Medium size, usually the same size or slightly larger than Virginia Savoy on the same date, and as it stands longer without seedstalks, it may attain a weight 20 to 50 percent greater. Somewhat flatter or more spreading in habit than Virginia Savoy.

PETIOLE

Same size or slightly larger than Virginia Savoy.

BLADE

Same color as Virginia Savoy but not as heavily savoyed, especially on the margins; more nearly halberd shape with sharper pointed tips and basal lobes, larger size.

SEED

Medium size, round, smooth.

HISTORY

The result of selection from a cross between Virginia Savoy and King of Denmark. Developed at the Virginia Truck Experiment Station and introduced in 1929.

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[7] The description of this variety is a comparative one based on observations rather than on actual measurements as with other varieties herein described.

DARK GREEN BLOOMSDALE

BRIEF CHARACTERIZATION

Grown for home use, market, and shipping as a wintered-over crop where blight (mosaic) is not prevalent or as a very early sown spring crop.

Fast growing and produces seedstalks only a few days later than Virginia Savoy. Plants small to medium in size with erect-growing, medium-length, medium-thick petioles which hold well above the soil most of the dark-green, heavily savoyed, oval-shaped, curved blades.

ADAPTABILITY AND USE

Dark Green Bloomsdale is the most important variety for winter culture in the South, as it grows rapidly, is hardy, and holds its dark-green color well during shipment. It is also used for the wintered-over and the early spring crop in the Atlantic coast region where blight (mosaic) is not present. Dark Green Bloomsdale is a distinct improvement over the original Bloomsdale Savoy in that it is longer standing, darker green, and more heavily savoyed. It has almost completely replaced the original type; however, it is still sometimes sold under the name of Bloomsdale Savoy. For home use and market garden it is being displaced by Long Standing Bloomsdale, and in sections where mosaic occurs, by Virginia Savoy and Old Dominion.

SEASON

Fast growing, reaching 10 cm (4 inches) in diameter in 17 to 35 days from date of germination when grown in the North as a spring-sown crop, but requiring from 55 to 90 days to reach the same size when grown as a winter-sown crop in Texas and California. Quick to produce seedstalks, requiring from 32 to 50 days from date of germination for first seedstalks to appear when grown as a spring-sown crop in the North. As a winter-sown crop in Texas and California its first seedstalks appear in 70 to 100 days after germination.

PLANT [8]

(Pls. 1, 4, and 5)

Medium in size, usually 50 to 100 g (1¾ to 3½ ounces) average weight as a spring-sown crop in the North and East and 90 to 140 g (3⅙ to 5 ounces) as a winter crop in Texas and California; average height, 10 to 15 cm (4 to 6 inches); average spread or width of 22 to 30 cm (8½ to 12 inches), which is approximately 1.8 to 2.4 times the height. Typically erect-growing or vase-shaped but with continuous high temperatures and short days, as in Texas in 1931, becomes flattened or inverted-saucer shaped. Very little axillary growth except in the winter-grown crops. Average number of leaves over 1 inch in length typically 13 to 20 in number, but under extreme environments as few as 12 and as many as 30.

PETIOLE

Lighter green (20 J 7) than blade, underground portion of petioles and taproot pale purplish pink (2 D 4) on about one-third of plants, the majority white or light-cream color; medium length, typically 6 to 8 cm (2⅜ to 3⅛ inches) long, 0.55 to 0.75 cm (seven thirty-seconds to five-sixteenths inch) wide, and 8 to 12 times as long as wide; under extremes of environment the average petiole length ranging from 4.6 to 16.9 cm (1¾ to 6½ inches), width from 0.44 to 0.92 cm (three-sixteenths to three-eighths inch) and the ratio of length to width from 8.6 to 16.8; straight or slightly curved; almost round in cross section with a range in ratio of depth to width of 0.97 to 1.1; held at an angle of 40° to 75° with the horizontal, thus holding most of the blades above the soil.

BLADE

Glistening dark green (23 L 6) on upper surface, glistening medium green (22 K 6) on lower surface; heavily savoyed over entire surface; veins inconspicuous because of depressed nature; medium size, typically 9 to 13 cm (3½ to 5 inches) wide, 10 to 14 cm (4 to 5½ inches) long, 1.00 to 1.12 times as long as wide, and 1.40 to 1.75 times as long as the petiole; under extremes of environment average width ranging from 7.4 to 12.4 cm (3 to 4⅞ inches), length from 8.4 to 13.3 cm (3¼ to 5¼ inches), range in ratio of length to width from 1.01 to 1.34 and of blade length to petiole length from 1.18 to 1.90. General shape is broad ovate with one pair of blunt-pointed basal lobes but is obscured by curling down of edges so that leaf appears to be oval in shape; tip round-pointed to round; base cordate; viewed from side and end, blade is convex and margin curls downward except under continuous high temperatures when it becomes almost flat.

SEED

Medium size, round, smooth.

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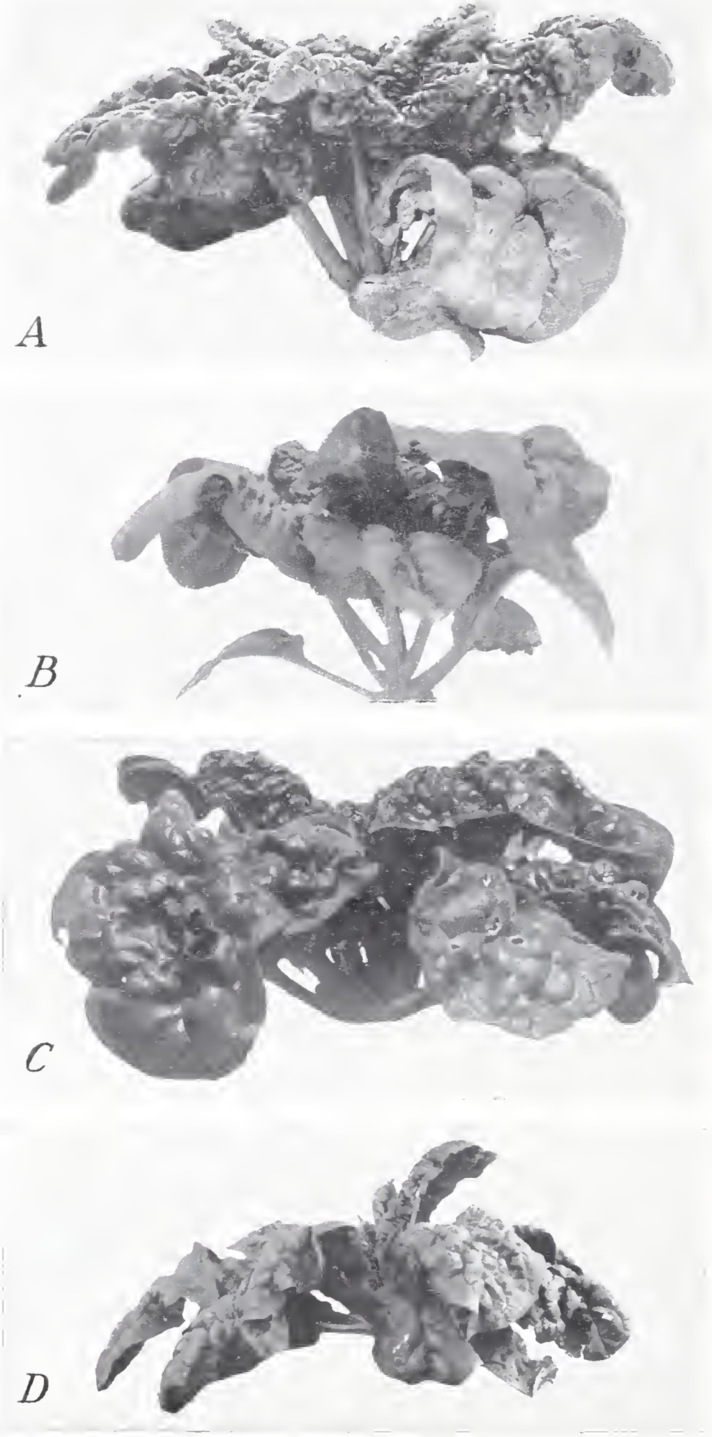
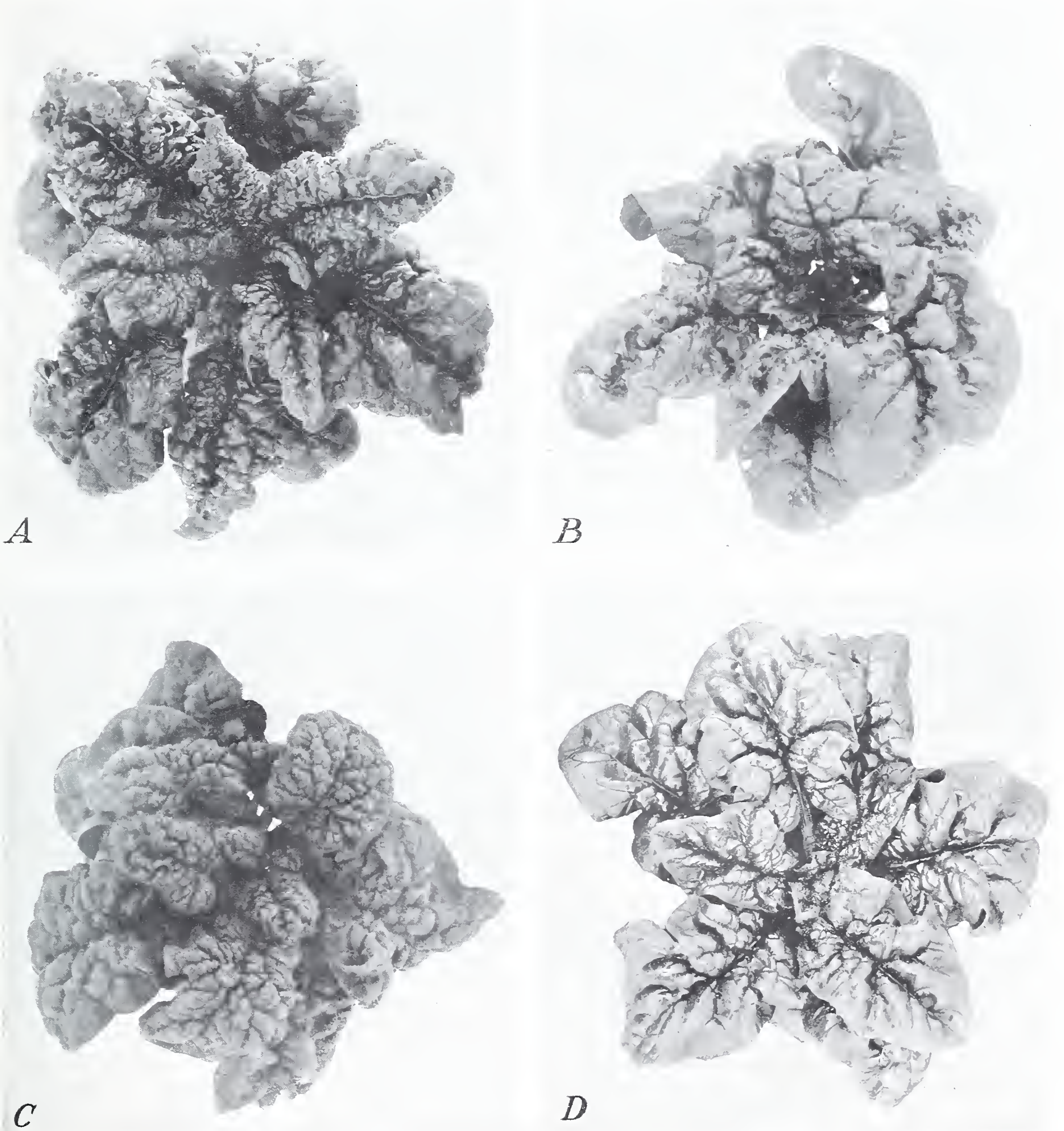
[8] For details of variation in plant characters induced by environment, see tables in Appendix and discussion on p. 5.

DARK GREEN BLOOMSDALE SPINACH



Typical plants of Dark Green Bloomsdale spinach grown in (A) *Virginia in 1932,* (B) *New York in 1931,* (C) *California in 1931, and* (D) *Texas in 1931.* × 1/3.

DARK GREEN BLOOMSDALE SPINACH



Typical plants of Dark Green Bloomsdale spinach grown in (A) *Virginia in 1932,* (B) *New York in 1931,* (C) *California in 1932, and* (D) *Texas in 1931.* × 1/3.

SYNONYMS

American Curled Savoy Leaved; Bloomsdale; Bloomsdale Curled Savoy Leaved; Bloomsdale or Savoy Leaved; Bloomsdale or Norfolk Savoy Leaved; Bloomsdale Reselected; Bloomsdale Reselected Dark Green; Bloomsdale Savoy; Curled Bloomsdale; Curled Leaf Savoy; Curled Savoy; Curled Savoy Leaved; Extra Curled Bloomsdale Savoy; Extra Dark Green Bloomsdale; Norfolk Savoy Leaved; Reselected Savoy Leaved; Round Seeded Savoy; Savoy Leaved Norfolk; Savoy Leaved or Bloomsdale.

No easily discernible differences have been observed between the majority of the stocks grown in this study of Dark Green Bloomsdale and Reselected Bloomsdale. The majority of the stocks received as Bloomsdale or Savoy Leaved were identical with Dark Green Bloomsdale, although the original Bloomsdale was lighter green in color and not as heavily savoyed.

SIMILAR VARIETIES

Presto and Harlem Market are synonyms of each other and are apparently identical in type with Dark Green Bloomsdale except that they have prickly seed instead of smooth and are slightly longer standing. Presto Blight Resistant, reported to be resistant to spinach blight, is slightly lighter green than Presto, but otherwise the same type.

HISTORY

Introduced in 1926 by Zwaan and Van der Molen, Voorburg, Netherlands, the result of selection from a single plant found in the Bloomsdale variety.

LONG STANDING BLOOMSDALE

BRIEF CHARACTERIZATION

Valuable as a succession variety to Dark Green Bloomsdale for spring sowing, as it is of the same type but slower in producing its seedstalks.

Slower growing, later seeding, and somewhat flatter in habit than Dark Green Bloomsdale. Plants medium in size with erect-spreading, medium-length, medium-thick petioles and dark-green, heavily savoyed, oval-shaped, curved blades.

ADAPTABILITY AND USE

Long Standing Bloomsdale is especially valuable in extending the season for the savoyed type, as it remains in marketable condition longer than other savoyed varieties except Juliana. Because of its larger size it is preferred by growers for the market and cannery. It is not recommended for fall planting, as it grows more slowly than Virginia Savoy or Old Dominion and is not mosaic- or blight-resistant.

SEASON

Slower growing than Dark Green Bloomsdale, requiring 25 to 38 days from date of germination to reach 10 cm (4 inches) in diameter when sown in the spring in the Northern States and 60 to 95 days when sown in the winter in Texas or California. Slow to produce seedstalks, requiring 39 to 60 days as a spring-sown crop in the North and East and 80 to 130 days as a winter-sown crop in the West and Southwest from date of germination for first seedstalks to appear.

PLANT[9]

(Pls. 1, 6, and 7)

Medium size, typically 90 to 170 g (3 to 6 ounces) average weight, 9 to 13 cm (3½ to 5 inches) average height, 20 to 30 cm (8 to 12 inches) average spread, approximately 2.0 to 2.6 times as wide as high; under extremes of environment ranging from 43 to 189 g (1½ to 6⅔ ounces) in average weight, 5.8 to 13.8 cm (2¼ to 5½ inches) in height, 19.9 to 34.7 cm (7¾ to 13¾ inches) in spread, and 1.86 to 4.29 times as wide as high; erect to erect-spreading in habit, with very little axillary growth. Number of leaves usually 15 to 25 but under extreme environmental conditions may range from 13 to 29.

PETIOLE

Lighter green (20 J 7) than blade, underground portion of petiole and taproot pale purplish pink (2 D 4) on 94 to 96 percent of plants, white or light-cream color on the remainder; medium length, typically 6 to 8 cm (2⅜ to 3⅛ inches) long, 0.55 to 0.80 cm (seven-thirty-seconds to five-sixteenths inch) wide, and 8 to 12 times as long as wide; under extremes of environment ranging from 4.5 to 7.9 cm (1¾ to 3⅛ inches) in average length, 0.42 to 0.85 cm (three-sixteenths to eleven-thirty-seconds inch) and 7.4 to 14.4 times as long as wide; straight to slightly curved; almost round in cross sections with a range in ratio of depth to width of 1.00 to 1.23; held at an angle of 30° to 70° with the horizontal.

BLADE

Glistening dark green (23 L 6) on upper surface, glistening medium green (22 K 6) on lower surface; heavily savoyed over the entire surface, veins inconspicuous because of depressed nature; medium size, typically 9 to 13 cm (3½ to 5 inches) wide, 9 to 14 cm (3½ to 5½ inches) long, 1.00 to 1.12 times as long as wide, and 1.50 to 1.95 times as long as the petiole; under extremes of environment ranging from 7.2 to 13.3 cm (2¾ to 5¼ inches) in average width, 8.5 to 17.6 cm (3⅜ to 7 inches) in average spread, 0.96 to 1.32 times as long as wide and 1.39 to 2.23 times the petiole length. General shape is broad ovate with one pair of blunt-pointed basal lobes, but shape is obscured by curling under of edges which results in oval appearance of blade; tip round-pointed to round; base cordate; viewed from side and end, blade is convex with margins curved down or under.

SEED

Medium size, round, smooth.

SYNONYMS

Aristocrat; Bloomsdale Improved Long Standing Thick Leaved; Bloomsdale Long Standing; Bloomsdale Savoy Long Standing; Burlington or Late Seeded Bloomsdale; Hot Weather; Late Seeding; Long Standing Savoy Leaved; Reselected Bloomsdale Long Standing; Special Summer Savoy; Summer Savoy. Although Summer Savoy is reputed to be slightly flatter in habit than Long Standing Bloomsdale, no consistent difference could be detected in the stocks tested.

HISTORY

Introduced in 1925 by Zwaan and Van der Molen, Voorburg, Netherlands. Developed by inbreeding a monoecious plant found in the Bloomsdale variety.

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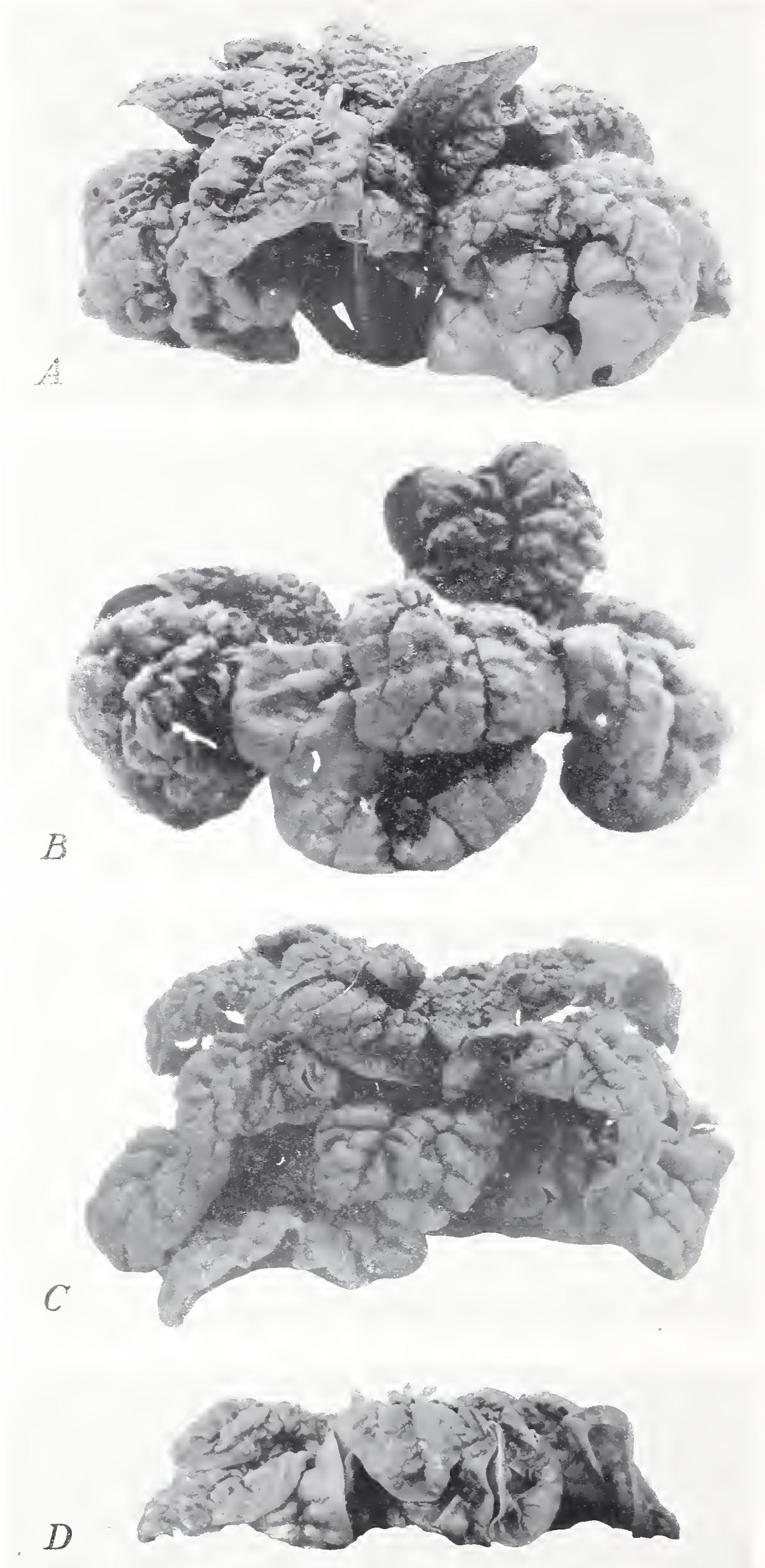
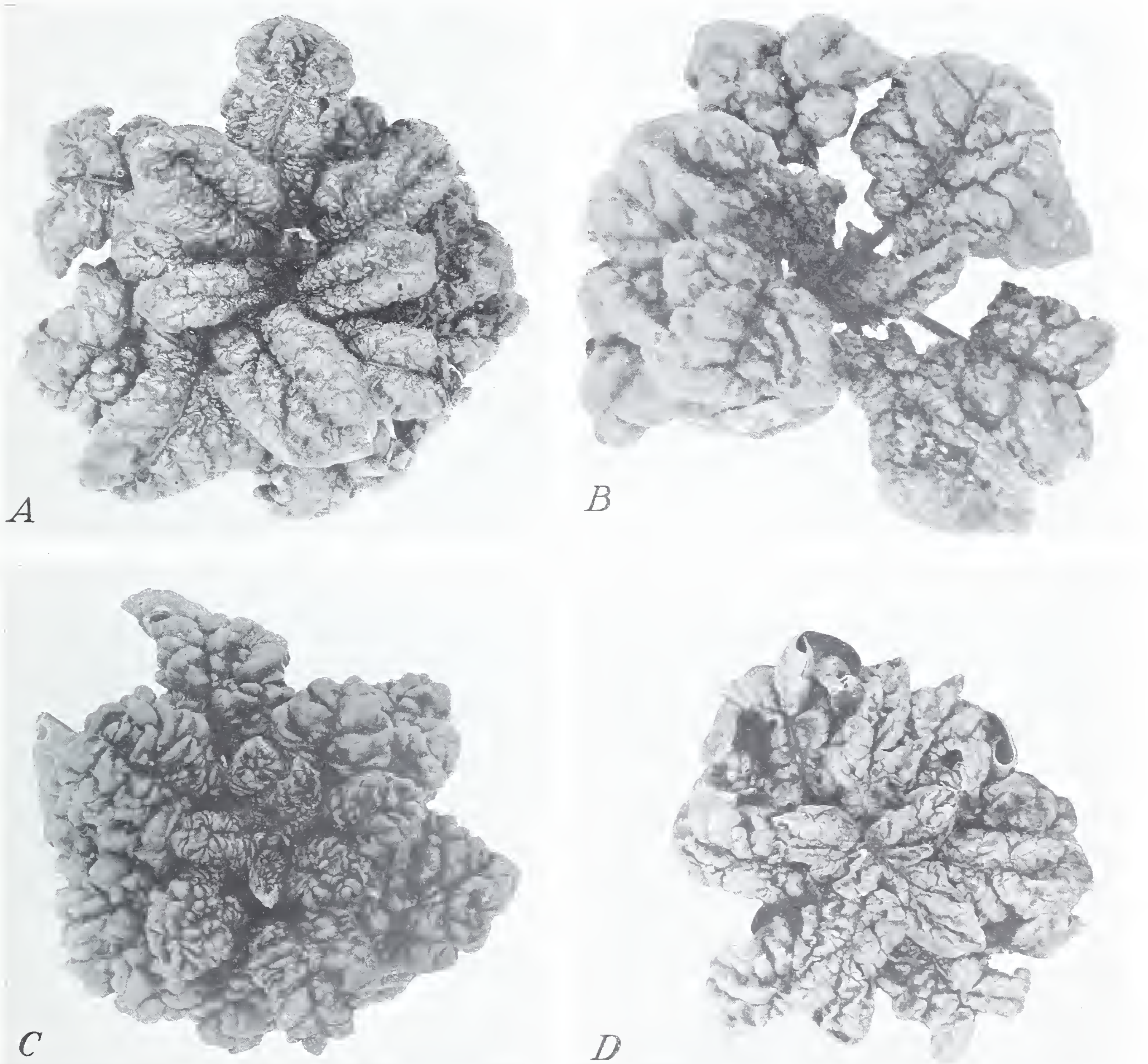
[9] For details of variation in plant characters induced by environment see tables in Appendix and discussion on p. 5.

LONG STANDING BLOOMSDALE SPINACH



Typical plants of Long Standing Bloomsdale spinach grown in (A) *Virginia in 1931,* (B) *New York in 1932,* (C) *California in 1932, and* (D) *Texas in 1931.* × 1/3.

LONG STANDING BLOOMSDALE SPINACH



Typical plants of Long Standing Bloomsdale spinach grown in (A) *Virginia in 1931,* × 1/4; (B) *New York in 1931,* × 1/3.5; (C) *California in 1931,* × 1/4; (D) *Texas in 1931,* × 1/3.

JULIANA

BRIEF CHARACTERIZATION

Valuable for home use and market garden in extending the season where the savoy type is preferred, as it is the slowest of the savoy varieties to produce seedstalks. It is not an important variety in any commercial shipping section because of its small size and slow growth.

Slow growing and slow to produce seedstalks. The tips of the larger leaves touch the soil forming an inverted bowl-shaped, very compact or dense plant. Plant small, recumbent in habit with erect spreading, short, stout petioles and blue-green, heavily savoyed, oval to round, curved blades.

ADAPTABILITY AND USE

Juliana is decreasing in importance in the United States because of its slow growth and small size. It is of value, however, for the home and market gardener in extending the season where the dark-green, heavily savoyed type is preferred.

SEASON

Slow growing, reaching 10 cm (4 inches) in diameter in 33 to 42 days from date of germination when grown as a spring-sown crop in the North and East and in 65 to 105 days when grown as a winter-sown crop in the West and Southwest. Very slow to produce seedstalks, requiring from 45 to 60 days when spring sown in the North and East and 90 to 140 days when winter sown in West and Southwest for the first seedstalks to appear.

PLANT[10]

(Pls. 1 and 8)

Small size, typically 70 to 120 g ($2\frac{1}{2}$ to 4 ounces) in average weight, 7 to 10 cm ($2\frac{3}{4}$ to 4 inches) in average height, 20 to 30 cm (8 to 12 inches) in average spread, and 2.3 to 4.0 times as wide as tall; under extremes of environment ranging from 34 to 138 g ($1\frac{1}{5}$ to $4\frac{7}{8}$ ounces) in average weight, 5.2 to 11.8 cm (2 to $4\frac{5}{8}$ inches) in average height, 19.4 to 29.0 cm ($7\frac{1}{2}$ to $11\frac{1}{2}$ inches) in average spread, and 2.31 to 4.22 in ratio of spread to height. Uniformly very compact, inverted-saucer shape with practically no axillary growth. Number of leaves over 1 inch in length usually 15 to 23 but may range from 12 to 24 under extreme environments.

PETIOLE

Lighter green (20 J 7) than blade with underground portion of petioles and taproot pale purplish pink (2 D 4) on all plants; short, typically 4 to 6 cm ($1\frac{1}{2}$ to $2\frac{3}{8}$ inches) long, 0.50 to 0.75 cm (three-sixteenths to five-sixteenths inch) wide, and 6 to 9 times as long as wide; under extremes of environment ranging from 3.7 to 6.2 cm ($1\frac{7}{16}$ to $2\frac{7}{16}$ inches) in average length, 0.45 to 0.86 cm (five thirty-seconds to eleven thirty-seconds inch) in width, and 5.9 to 9.7 times as long as wide; straight; round to elliptical in cross section with a range in ratio of depth to width of 0.97 to 1.52; held at an angle of 20° to 45° with the horizontal.

BLADE

Glossy blue green (24 L 4) on upper surface, dull medium green (22 K 7) on lower surface, heavily savoyed over entire surface; veins inconspicuous because of depressed nature; small, typically 8 to 10 cm ($3\frac{1}{8}$ to 4 inches) wide, 8 to 12 cm ($3\frac{1}{8}$ to $4\frac{3}{4}$ inches) long, 1.00 to 1.15 times as long as wide, and 1.8 to 2.1 times as long as the petiole; under extremes of environment ranging in average width from 5.7 to 10.9 cm ($2\frac{1}{4}$ to $4\frac{1}{4}$ inches), average length from 7.5 to 14.7 cm (3 to $5\frac{3}{4}$ inches), range in ratio of length to width from 0.94 to 1.52 and of blade length to petiole length from 1.80 to 2.94. General shape round to oval with one pair of shallow basal lobes; tip rounded; base cordate; viewed from side and end, blade is convex with reclined margins.

SEED

Small, round, smooth.

SYNONYMS

Princess Juliana is the introducer's name for this variety. Common usage has made the shorter name, Juliana, generally acceptable.

HISTORY

Introduced in 1921 by Zwaan and DeWiljes, Scheemda, Netherlands. It was developed by inbreeding a monoecious plant found in the Long Season variety.

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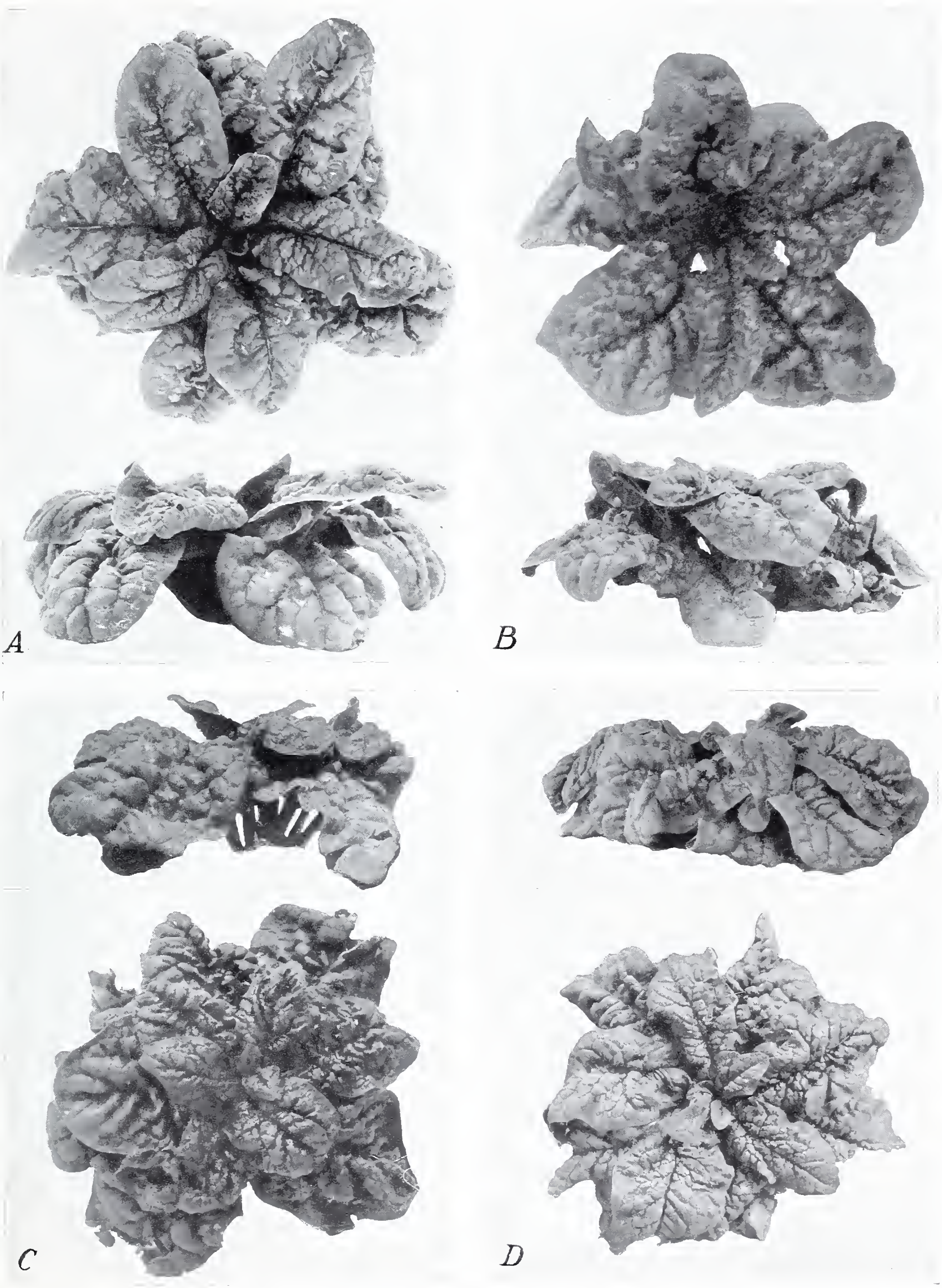
[10] For details of variation in plant characters induced by environment see tables in Appendix and discussion on p. 5.

JULIANA SPINACH



Typical plants of Juliana spinach grown in (A) *Virginia in 1931,* (B) *New York in 1932,* (C) *California in 1931, and* (D) *Texas in 1931.* × ¹/₃. *Note uniformity in habit, type, and size.*

KING OF DENMARK

BRIEF CHARACTERIZATION

Valuable for home use, market, and canning purposes as a late spring crop in the North because of its long-standing quality (slow to shoot to seed) and productiveness.

Fairly slow growing and the slowest smooth-leaved variety to produce seedstalks. Plant large, with erect spreading leaves when young but becoming quite flat in habit and open-centered with maturity. Petioles long, medium thick, slightly ascending to recumbent with large, blue-green, almost smooth, oval to hastate, reclined or flat blades with reclined or flat margins.

ADAPTABILITY AND USE

The King of Denmark is the slowest of the smooth-leaved varieties to produce seedstalks and, therefore, is valuable in extending the season for home and market gardeners. It is also used to some extent for canning in the Northeastern States, but the long petioles necessitate heavy trimming and losses in preparation. Grows too slowly during the winter in California and, therefore, is not as productive as Viroflay or Hollandia. The popularity of this variety has diminished with the introduction of dark-green strains of the Nobel variety.

SEASON

Fairly slow growing, requiring 20 to 40 days from date of germination to reach 15 cm (6 inches) in diameter when sown as a spring crop in the North and East and 60 to 105 days as a winter-sown crop in the West and Southwest. Very slow to produce seedstalks, requiring from 55 to 70 days from date of germination in the North and East and 80 to 135 days in the West and Southwest for the appearance of the first seedstalks.

PLANT [11]

(Pls. 1, 9, 10, 11, and 12)

Large size, typically 100 to 300 g (3½ to 10½ ounces) in average weight, 8 to 14 cm (3 to 5½ inches) in average height, 40 to 55 cm (15¾ to 21¾ inches) in spread and 3 to 6 times as wide as tall; under extremes of environment ranging in average plant weight from 47 to 378 g (1⅔ to 13⅓ ounces), average height from 2.7 to 20.8 cm (1 1/16 to 8 3/16 inches), average spread from 31.1 to 64.0 cm (12¼ to 25¼ inches), and 2.4 to 11.4 times as wide as high. When young, the leaves tend to grow somewhat erect, but as the plants age the leaves assume a flat or prostrate position if given space enough to prevent crowding. Centers of the plants are open in spite of considerable axillary growth which sometimes develops before the seedstalk elongates. Average number of leaves over 1 inch in length 15 to 25 but under extreme conditions may range from 11 to 41.

PETIOLE

Much lighter green (20 J 7) than blade, underground portion of petioles and taproot pale purplish pink (2 D 4) on all plants; long, typically 8 to 12 cm (3 to 4¾ inches) long, 0.50 to 0.75 cm (three-sixteenths to five-sixteenths inch) wide, and 15 to 19 times as long as wide; under extremes of environment ranging in average length from 6.6 to 13.0 cm (2⅝ to 5 inches), average width 0.46 to 0.77 cm (five thirty-seconds to five-sixteenths inch), and 11.7 to 23.2 times as long as wide; curved and sometimes twisted so as to reverse the normal position of blade surfaces, generally oval in cross section with a range in ratio of depth to width of 1.06 to 1.34; leave the main axis at 0° to 45° with the horizontal but usually curve or twist until the base of the blade is almost on the soil (pls. 10 and 12).

BLADE

Dull blue green (24 L 4) on upper surface, glistening medium green (22 K 7) on lower surface; slightly crumpled or bullate near the base of younger leaves but commonly smooth on the older leaves of the spring-grown crop; veins conspicuous because of lighter color; large size, typically 10 to 15 cm (4 to 6 inches) wide, 12 to 20 cm (4¾ to 8 inches) long, 1.1 to 1.4 times as long as wide, and 1.5 to 2.0 times as long as petiole; under extremes of environment ranging in average width from 8.4 to 16.0 cm (3¼ to 6¼ inches), average length from 9.8 to 27.9 cm (3⅞ to 11 inches), ratio of length to width from 1.06 to 1.74 and of blade length to petiole length from 1.35 to 2.28. General shape broad hastate with one to three shallow, blunt-pointed lobes, although under conditions which cause the lobes and edges to curve down or curl under, it appears broad lanceolate, elliptical or ovate; tip is blunt pointed to slightly rounded; base is tapered, rounded, square, or cordate. Viewed from the side and end, blades may be flat convex, undulate, or rarely concave.

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[11] For details of variation in plant characters induced by environment, see tables in Appendix and discussion on p. 5.

SEED

Medium size, round, smooth.

SYNONYMS

Antvorskov; Danish Summer, Large Round Leaved; Emerald Standing.

SIMILAR VARIETIES

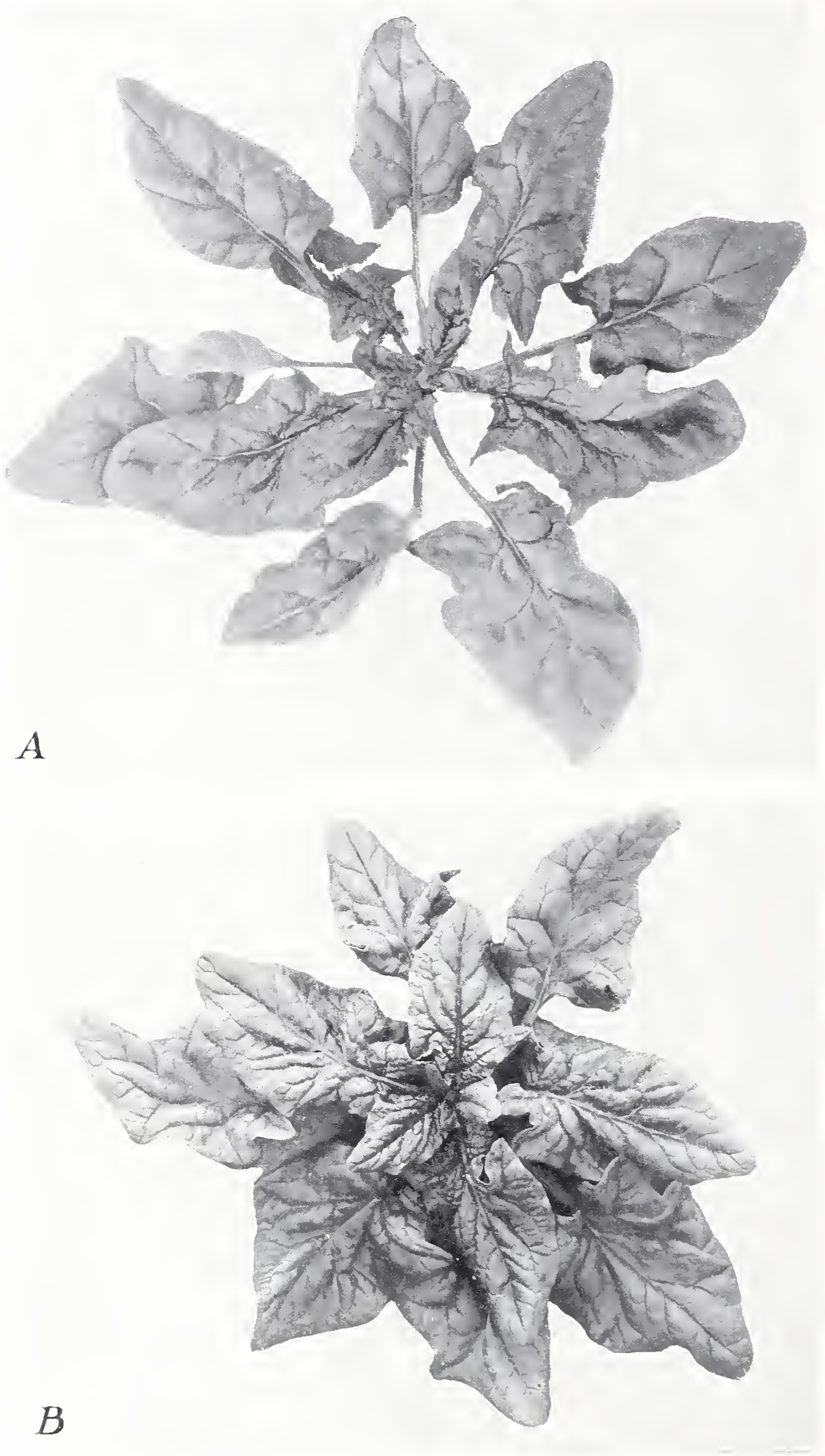
Darkie is similar but has shorter petioles, darker green, smoother, and thicker blades, and is slightly earlier in seeding.

Zenith is similar in color, habit, rate of growth, and seedstalk formation, but with shorter petioles.

HISTORY

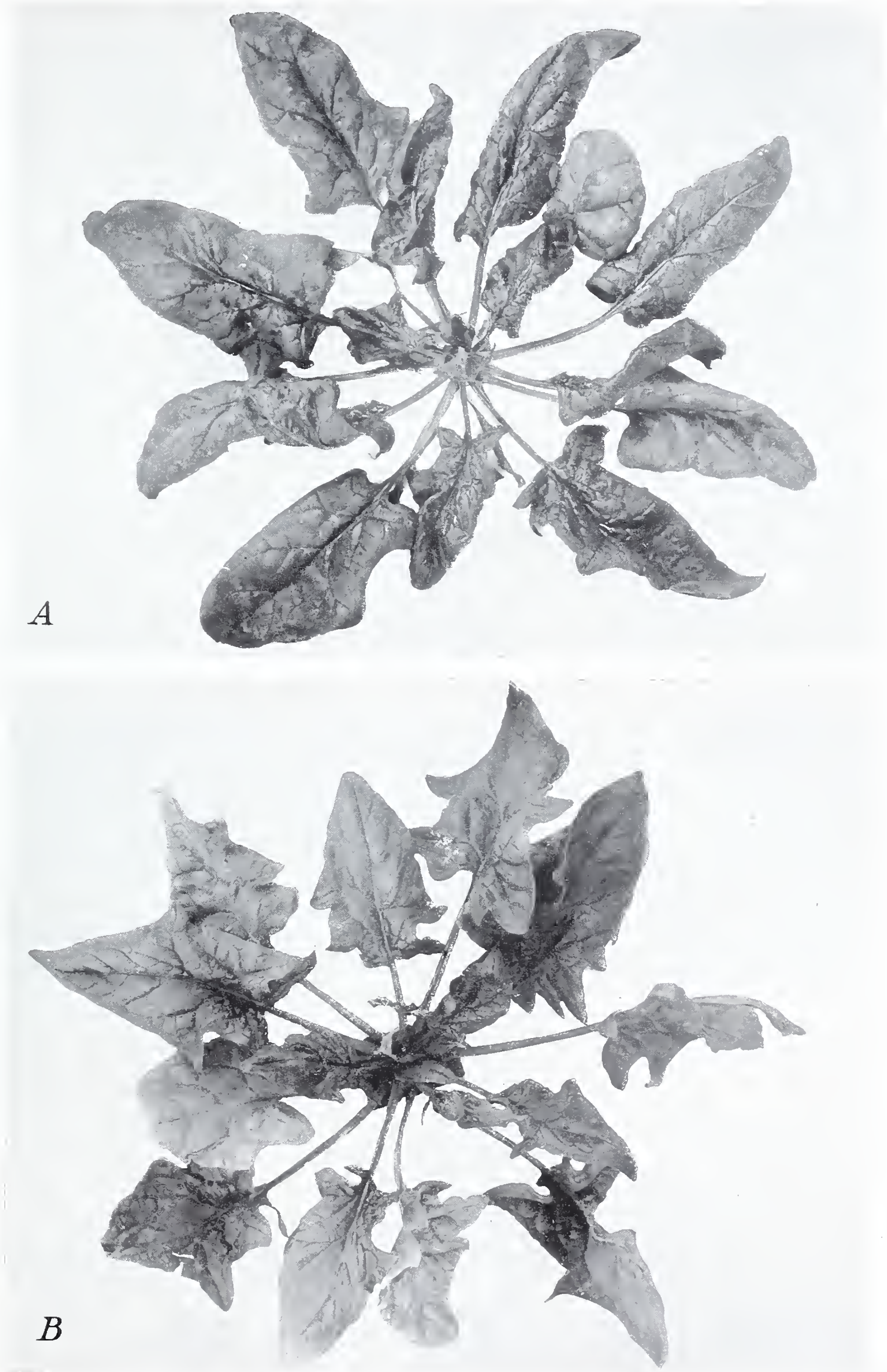
Introduced as "Antvorskov" by the originator, Thomas Madsen, Slagelse, Denmark, in 1919; renamed King of Denmark and introduced into the United States by Joseph Harris Co., Coldwater, N. Y., and listed as Antvorskov by Vaughans Seed Store, Chicago, Ill., in 1920.

KING OF DENMARK SPINACH



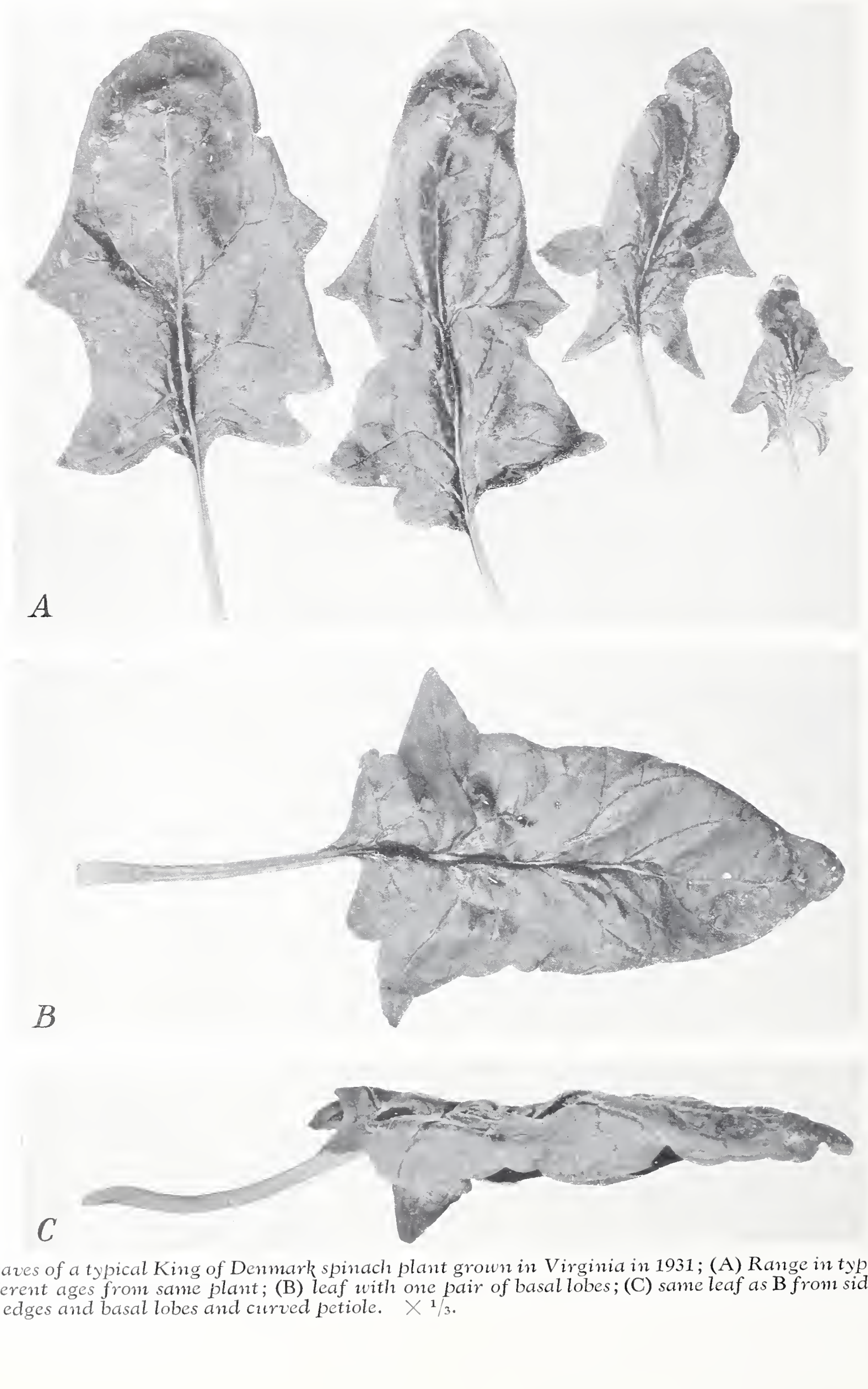
Typical plants of King of Denmark spinach grown in (A) *New York in 1931,* × $^{1}/_{4.8}$; (B) *T* × $^{1}/_{3}$. *Compare with plate 10.*

KING OF DENMARK SPINACH



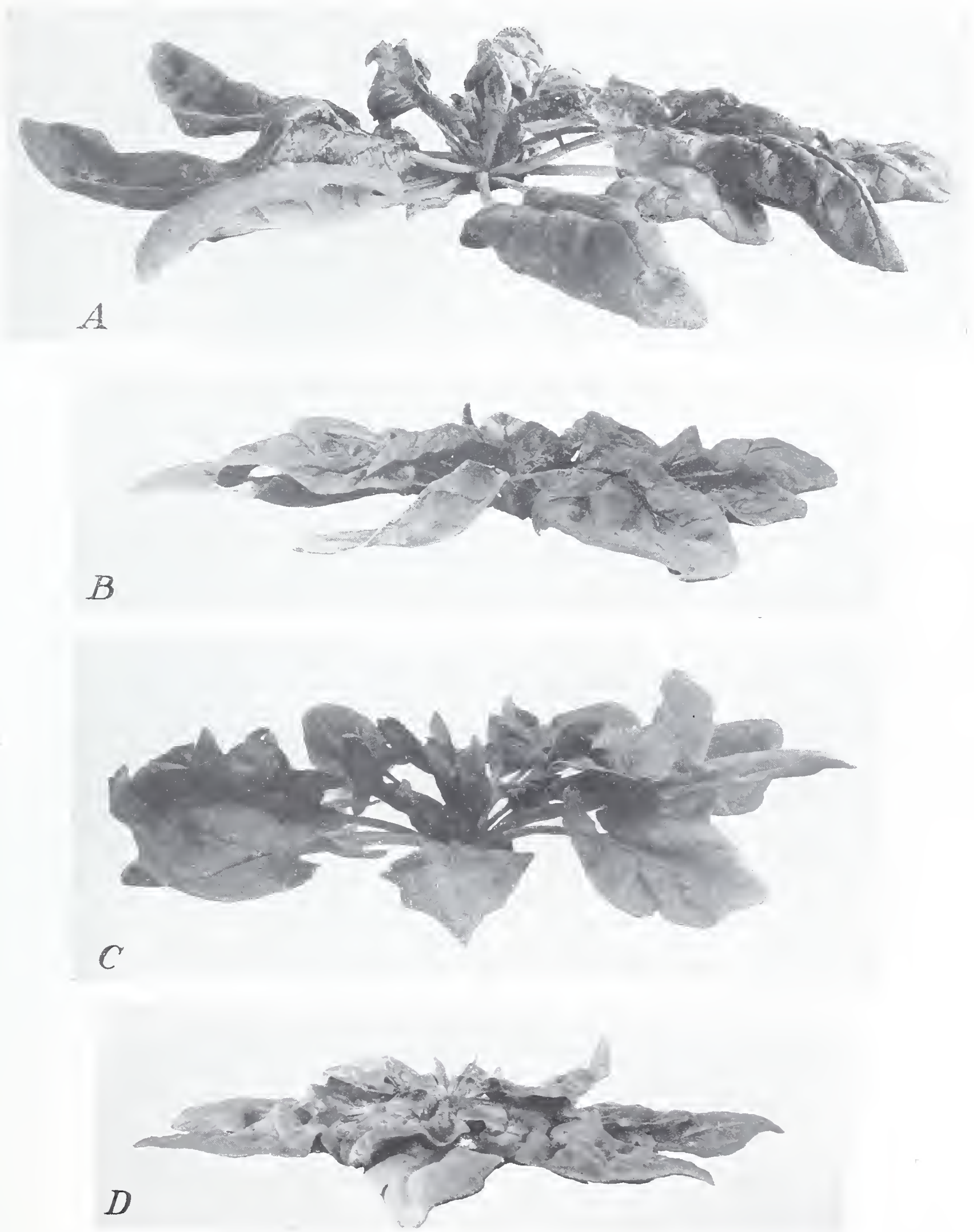
Typical plants of King of Denmark spinach grown in (A) *Virginia in 1931,* × 1/6; (B) *California in 1932,* × 1/3.

KING OF DENMARK SPINACH



Leaves of a typical King of Denmark spinach plant grown in Virginia in 1931; (A) *Range in type of leaves of different ages from same plant;* (B) *leaf with one pair of basal lobes;* (C) *same leaf as* B *from side with reclined edges and basal lobes and curved petiole.* × 1/3.

KING OF DENMARK SPINACH



Typical plants of King of Denmark spinach grown in (A) *Virginia in 1931,* × 1/5; (B) *New York in 1931,* × 1/4.8; (C) *California in 1932,* × 1/3; (D) *Texas in 1931,* × 1/3, *showing uniformly flat habit.*

VIROFLAY

BRIEF CHARACTERIZATION

Little used except for market and canning in California and from a small acreage in Texas for shipment to the Chicago market.

Fast growing and quick to shoot to seed. Plant large, with erect-spreading center leaves, procumbent large leaves, and an open or incompletely filled center. Petioles long, thick, slightly ascending to recumbent with large, medium-green, almost smooth, broad-hastate, flat blades with flat margins.

ADAPTABILITY AND USE

Viroflay makes rapid growth and large tonnage during the winter season in California and is extensively planted for the cannery crop in that State. It also grows well in Texas during the winter and a small acreage is grown each year for the Chicago market, which can dispose of a limited quantity of the flat-leaf type. It is being rapidly displaced by dark-green strains of Nobel for home and market gardens in the Northern States because of the latter variety's longer standing qualities.

SEASON

Fast growing, reaching 15 cm (6 inches) in diameter in 20 to 30 days from date of germination when grown as a spring-sown crop in the North and East and in 50 to 80 days when grown as a winter-sown crop in Texas or California. Quick to produce seedstalks, requiring 25 to 50 days in the North and East and 70 to 120 days in Texas and California from germination date to appearance of first seedstalks.

PLANT [12]

(Pls. 1, 13, 14, 15, and 16)

Medium in size in the North and East as a spring-sown crop, usually 50 to 150 g (1¾ to 5¼ ounces) average weight, and large in size in Texas and California, usually 125 to 300 g (4⅜ to 10½ ounces) and occasionally 400 g (14 ounces) average weight; average height from 10 to 15 cm (4 to 6 inches); average width or spread of 40 to 55 cm (15¾ to 21¾ inches) is approximately three to five times the height. Young plants and young leaves in center of mature plants erect spreading, older leaves procumbent; very little axillary growth except when grown as a winter crop. Number of leaves over 1 inch in length usually 16 to 22 but may range from 15 to 38 under extreme environments.

PETIOLE

Slightly lighter green (20 K 6) than blade; underground portion of petioles and taproot pale purplish pink (2 D 4) on all plants; long, typically 8 to 11 cm (3⅛ to 4¼ inches) long, 0.50 to 0.75 cm (three-sixteenths to five-sixteenths inch) wide, and 15 to 19 times as long as wide, under extremes of environment ranging from 7.9 to 13.0 cm (3⅛ to 5⅛ inches) in average length, 0.41 to 1.00 cm (three thirty-seconds to thirteen thirty-seconds inch) in width, and 10 to 24 times as long as wide; slightly curved, round to slightly oval in cross section with a range in ratio of depth to width of 0.94 to 1.29; held at an angle of 15° to 60° with the horizontal thus holding most of the blades, except the tips of the largest, above the soil.

BLADE

Medium green (22 K 7) on upper surface and slightly lighter green (21 K 7) on lower surface; base of younger blades sometimes slightly crumpled but older blades usually flat or smooth and especially so along the margin; medium to large, typically 12 to 17 cm (4¾ to 6¾ inches) wide, 15 to 20 cm (6 to 8 inches) long, 1.16 to 1.30 times as long as wide and 1.5 to 2.0 times as long as petiole; under extremes of environment ranging from 8.9 to 18.5 cm (3½ to 7¼ inches) in average width, 11.0 to 21.5 cm (4¼ to 8½ inches) in average length, 1.16 to 1.68 times as long as wide, and 1.40 to 2.14 times as long as the petiole. General shape broad halberd with one or two pointed lobes on each side; tip pointed to slightly rounded; base square to cordate; viewed from side or end, blade is flat or slightly convex, depending on whether the margins are flat or convex.

SEED

Medium size, round, smooth.

SYNONYMS

Early Thick Leaved; Flanders Broad Leaved; Improved Monstrous Viroflay; Improved Thick Leaved; Improved Thick Leaved Viroflay; Large Leaved Viroflay or Thick Leaf; Large Round Thick Leaf Viroflay; Large Round Leaved Viroflay; Monstrous or Viroflay; Monstrous Viroflay; Round Viroflay; Tempo.

SIMILAR VARIETIES

Winter Giant and Winter Success are similar but are slower growing and longer standing and have shorter petioles and broader blades in California as winter crops.

HISTORY

An old French variety whose date of origination or parentage is not known. It is thought to have been introduced into the United States about 1866.

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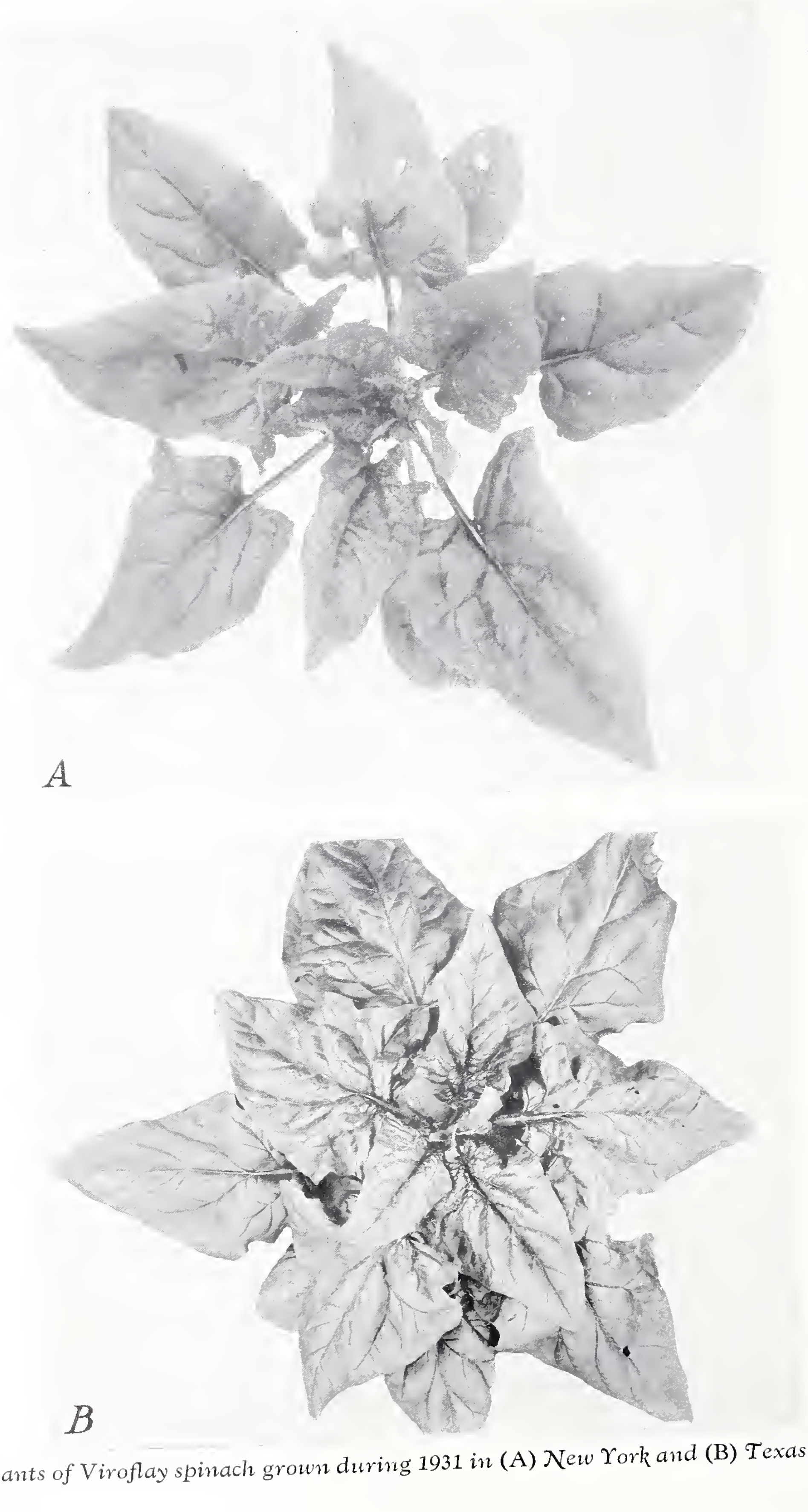
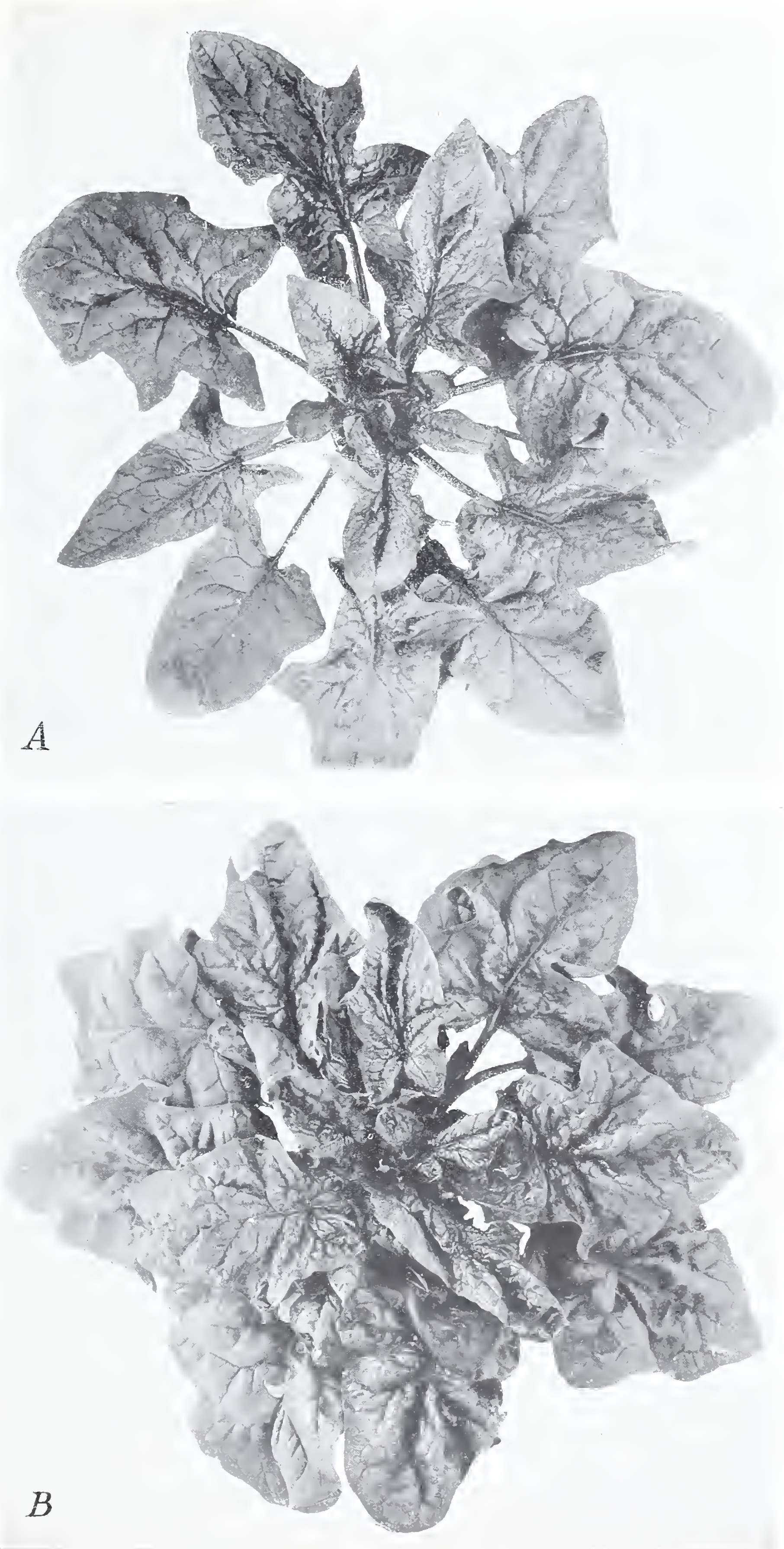
[12] For details of variation in plant characters induced by environment, see tables in Appendix and discussion on p. 5.

VIROFLAY SPINACH



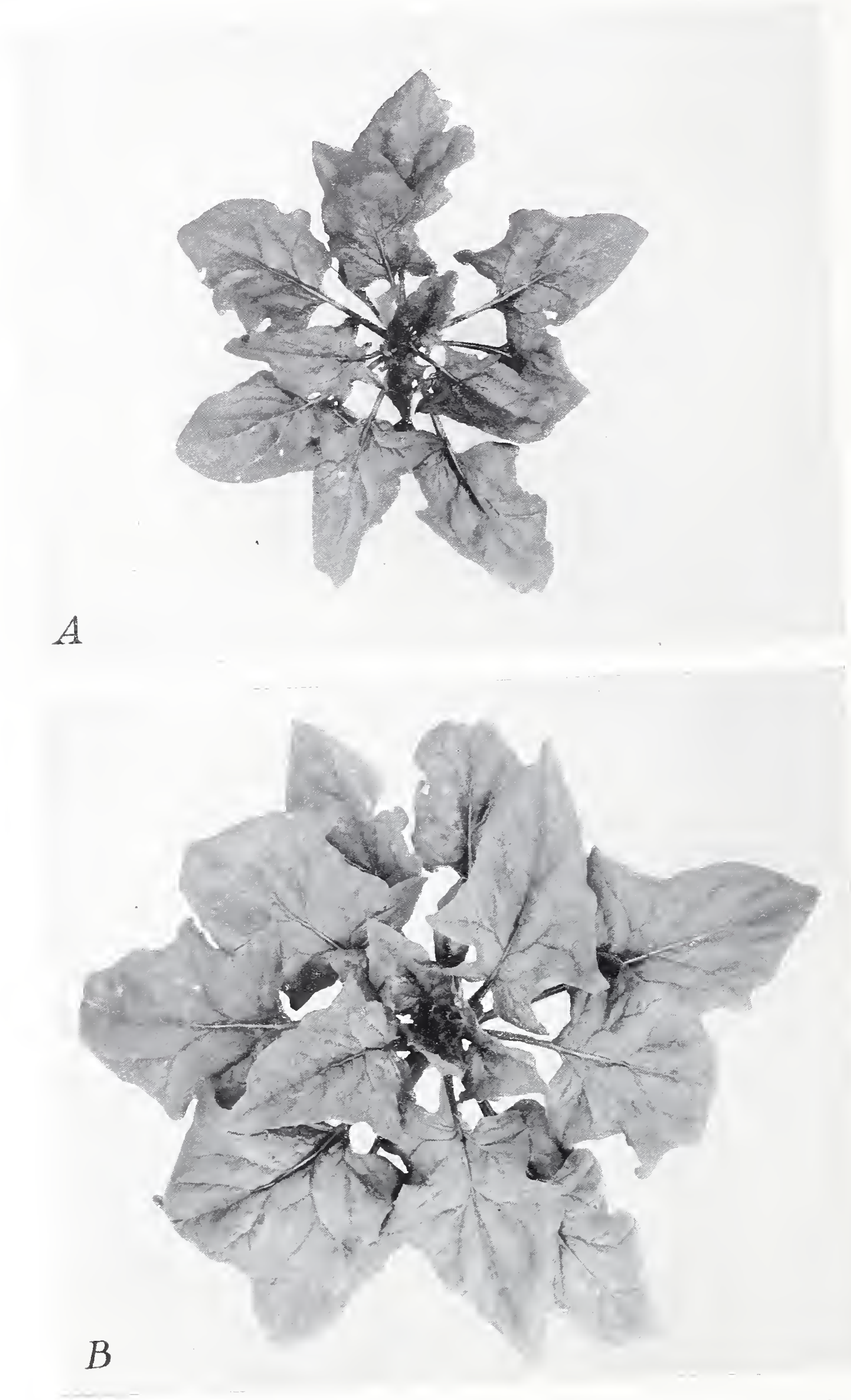
Typical plants of Viroflay spinach grown during 1931 in (A) *New York and* (B) *Texas.* × 1/3.

VIROFLAY SPINACH



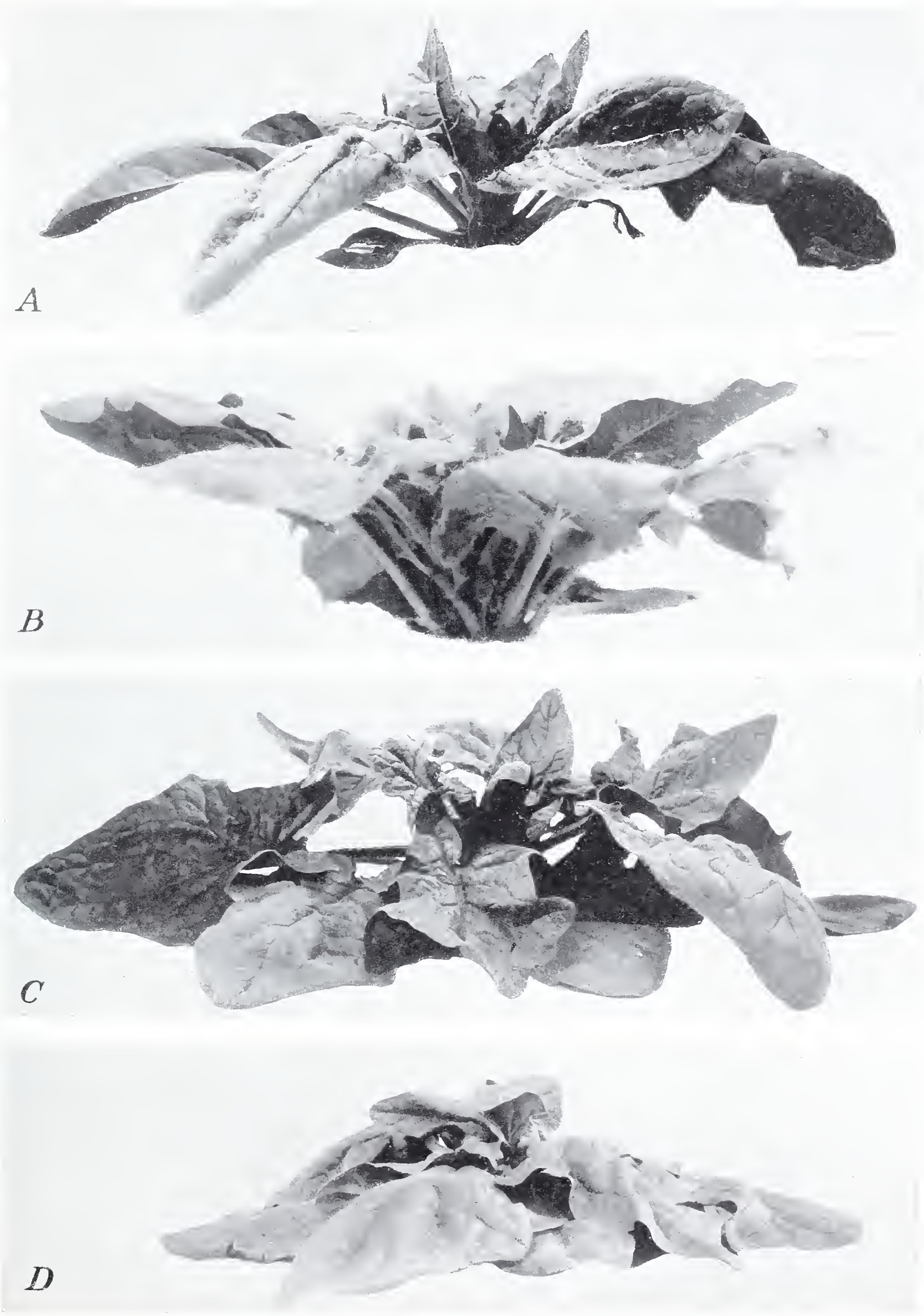
Typical plants of Viroflay spinach showing difference in size and smoothness of leaf when grown in (A) *California in 1932,* × 1/4; (B) *California in 1933,* × 1/5.

VIROFLAY SPINACH



Increase in size and number of leaves on same plant of Viroflay spinach due to 5 days' growth in 1934 at Arlington, Va.: (A) Photographed May 26, 1934; (B) photographed May 31, 1934. × 1/5.

VIROFLAY SPINACH



Typical plants of Viroflay spinach grown in (A) *Virginia in 1931,* (B) *New York in 1932,* (C) *California in 1932, and* (D) *Texas in 1931.* × 1/3.

NOBEL

BRIEF CHARACTERIZATION

Highly recommended for home use, market, and canning because of its speed of growth and long-standing quality, but not adapated for the winter-spring canning crop in California. The longest standing of the smooth-leaved varieties except King of Denmark and very productive.

Fast growing and long standing. Plant large, erect-spreading when crowded, but very flat or procumbent, forming compact rosette when given plenty of space. Petioles medium length, thick, slightly ascending to recumbent with large, light- to medium-green, almost smooth, broad-hastate blades with rounded tips and flat to slightly reclined margins.

ADAPTABILITY AND USE

Because of its rapid growth, slow seedstalk formation, and smoothness of leaf which makes it very easy to prepare for cooking, the dark-green strain of this type should soon become the most important home and market garden variety in the North and East. The same characters may make it valuable for canning, although it has not proved as generally valuable in California for the winter crop as Viroflay and Hollandia.

SEASON

Fast growing, reaching 15 cm (6 inches) in diameter in 20 to 30 days from date of germination when grown as a spring-sown crop in the North and East and in 60 to 80 days when grown as a winter-sown crop in Texas and California. Very slow to produce seedstalks, requiring from 40 to 55 days from date of germination in the North and East and 75 to 125 days in California and Texas for the appearance of the first seedstalks.

PLANT [13]

(Pls. 1, 17, 18, 19, 20, 21, and 22)

Large in size, typically 200 to 400 g (7 to 14 ounces) in weight, 10 to 15 cm (4 to 6 inches) in height, 45 to 55 cm (17¾ to 21¾ inches) in spread, and 3 to 6 times as wide as tall; under extremes of environment ranging from 73 to 410 g (2 3/10 to 14½ ounces) in average weight, 3.6 to 18.6 cm (1½ to 7¼ inches) in average height, 32 to 72 cm (12½ to 28½ inches) in average spread, and 2.5 to 9 times as wide as tall. Erect spreading in habit when young but gradually flatten and are very flat just before reaching maximum size. Just prior to seedstalk elongation the younger leaves assume an angle of about 45° with the horizontal, resulting in a broad vase- or flat V-shaped plant. When crowded in the row the plants assume this shape at an earlier stage of development. Considerable axillary growth on the latest seeding plants. Average number of leaves over 1 inch in length usually 18 to 25 but may range from 16 to 38 under extreme environments.

PETIOLE

Lighter green (20 K 6) than blades, underground portion of petioles and taproot pale purplish pink (2 D 4) on all plants; medium to long, typically 8 to 10 cm (3⅛ to 4 inches) long, 0.6 to 0.9 cm (one-fourth to eleven thirty-seconds inch) wide, and 10 to 15 times as long as wide; under extremes of environment ranging from 6.2 to 11.5 cm (2½ to 4½ inches) in average length, 0.46 to 1.08 cm (three-sixteenths to seven-sixteenths inch) in width, and 7 to 17 times as long as wide; slightly curved, nearly round in cross section with a range in ratio of depth to width of 0.87 to 1.17; held at an angle of 10° to 45° with the horizontal.

BLADE

Young leaves lighter green (22 L 5) than older leaves (22 K 7) on upper surface and still lighter (21 K 7) on the lower surface; young leaves and basal portion of larger leaves slightly crumpled but become smooth with age, smooth along the margins; veins inconspicuous because of depressed nature and similar color; large to very large; typically 12 to 17 cm (4¾ to 6¾ inches) wide, 17 to 22 cm (6¾ to 8½ inches) long, 1.2 to 1.4 times as long as wide, and 1.8 to 2.1 times as long as the petiole; under extremes of environment ranging from 8.7 to 20.9 cm (3½ to 8¼ inches) in average width, 9.6 to 32.7 cm (3¾ to 12⅞ inches) in average length, 1.10 to 1.56 times as long as wide, and 1.10 to 2.85 times as long as the petiole. Shape generally halberd with one or two shallow basal lobes; tip blunt-pointed to round; base square to slightly cordate; viewed from side, blade is flat, slightly convex, slightly concave, or partly convex and partly concave; from the end, blades are flat, slightly convex or slightly concave.

SEED

Medium size, round, smooth.

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[12] For details of variation in plant characters induced by environment, see tables in Appendix and discussion on p. 5.

SYNONYMS

Diamond or Diamant; Early Giant Smooth Leaf or Nobel; Enkhuizen Monstrous; Gaudflay; Gaudry Long Standing; Giant Fillbasket; Giant Leaved Long Standing Gaudry; Giant Nobel; Giant Smooth Leaved; Giant Thick Leaved; Large Round Thick Leaved; Large Round Thick Leaved Gaudry; Matador; Matador Longstanding Giant Leaved; Monstrous of Enkhuizen; New Long Standing Gaudry; Nobel Giant Leaved; Nobel Gaudry; Round Thick Leaf; Supra. Del Monte is same type but reported to be more satisfactory as a winter crop.

SIMILAR VARIETIES

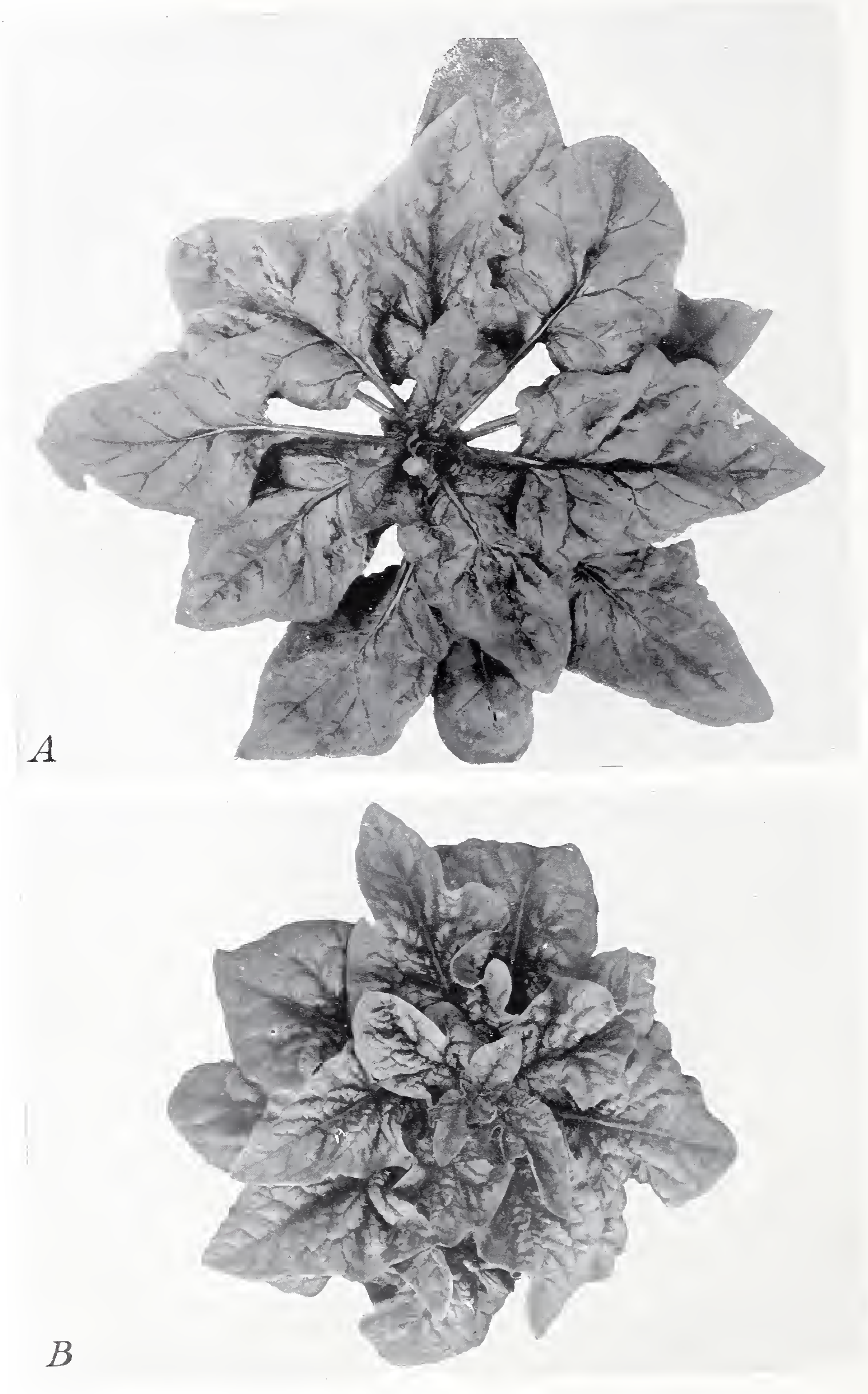
Giant Smooth Leaf Dark Green; Immerhorn; Northland; Queen of Holland have the same habit but are darker green and slightly slower seeding. Mercury, Resisto, Viking have rounder (more oval), more crumpled, darker green blades and are slightly slower seeding.

HISTORY

Introduced in 1926 by Zwaan and Van der Molen, Voorburg, Netherlands. It was developed by inbreeding a monoecious plant found in the Gaudry variety.

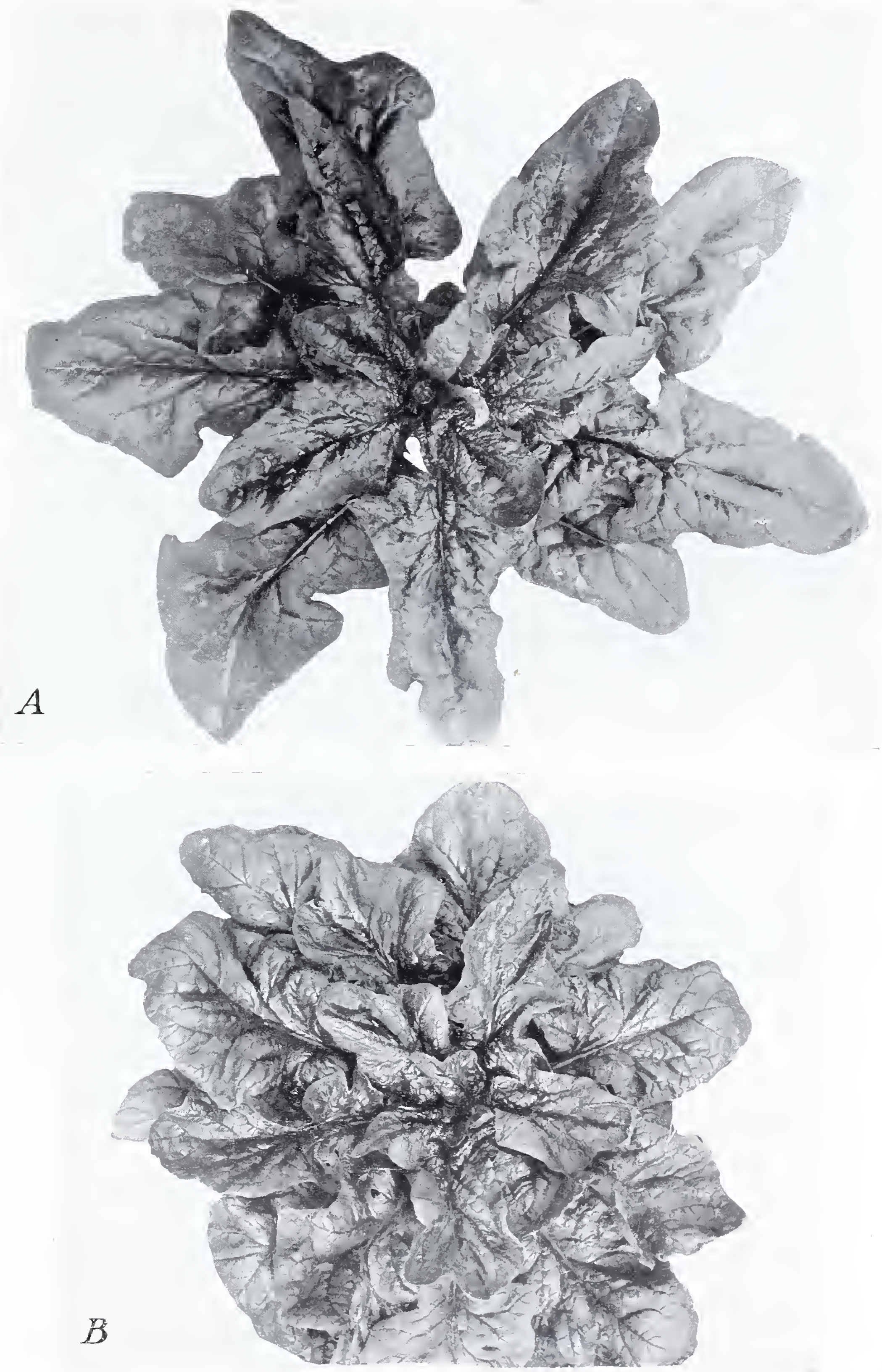
PLATE 17

NOBEL SPINACH



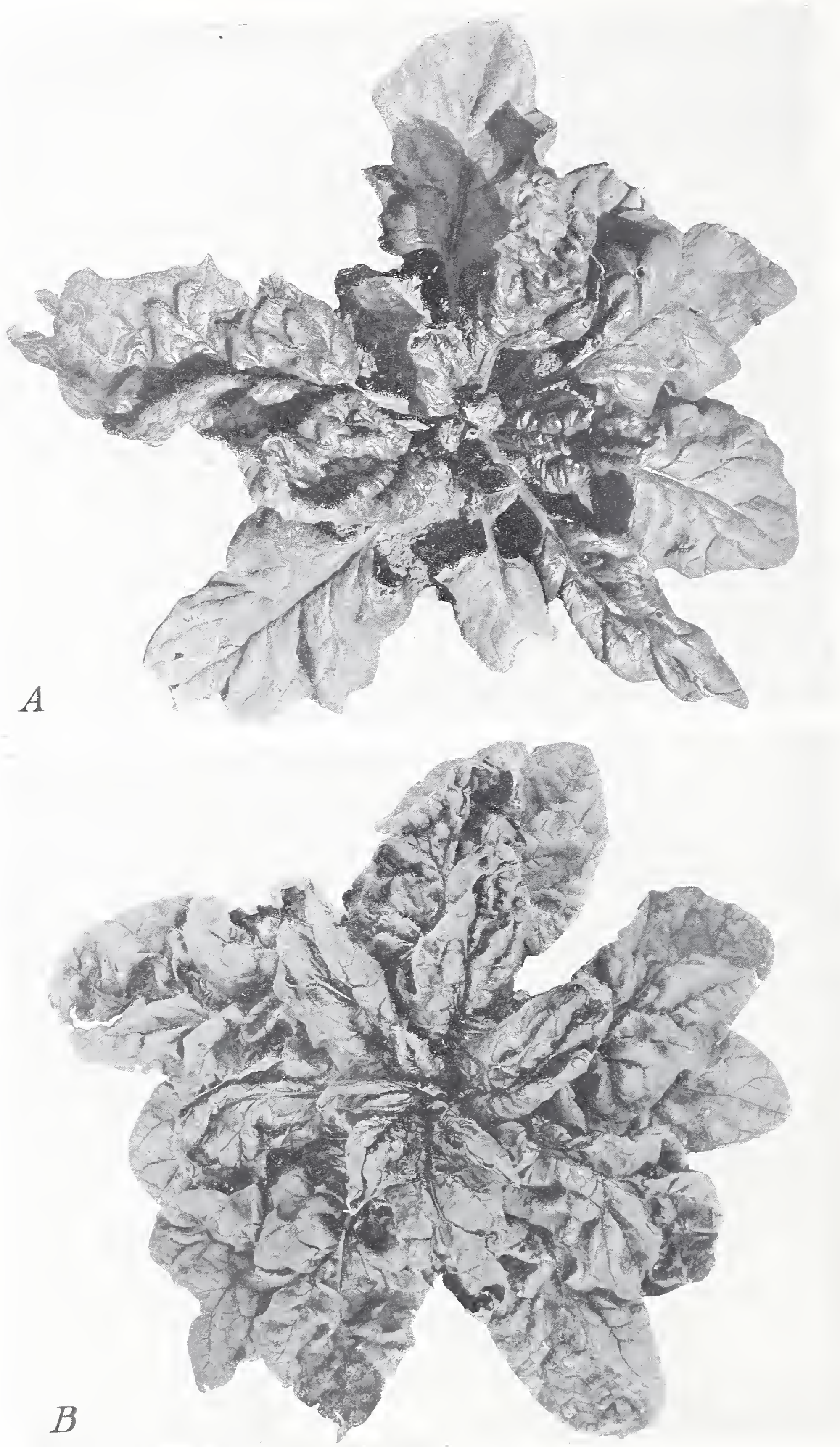
Typical plants of Nobel spinach grown in (A) *New York in* 1932, × $^{1}/_{4.8}$; (B) *Texas in* 1931, × $^{1}/_{3}$. *Compare with plate* 18 *and note difference in blade surface and size.*

NOBEL SPINACH



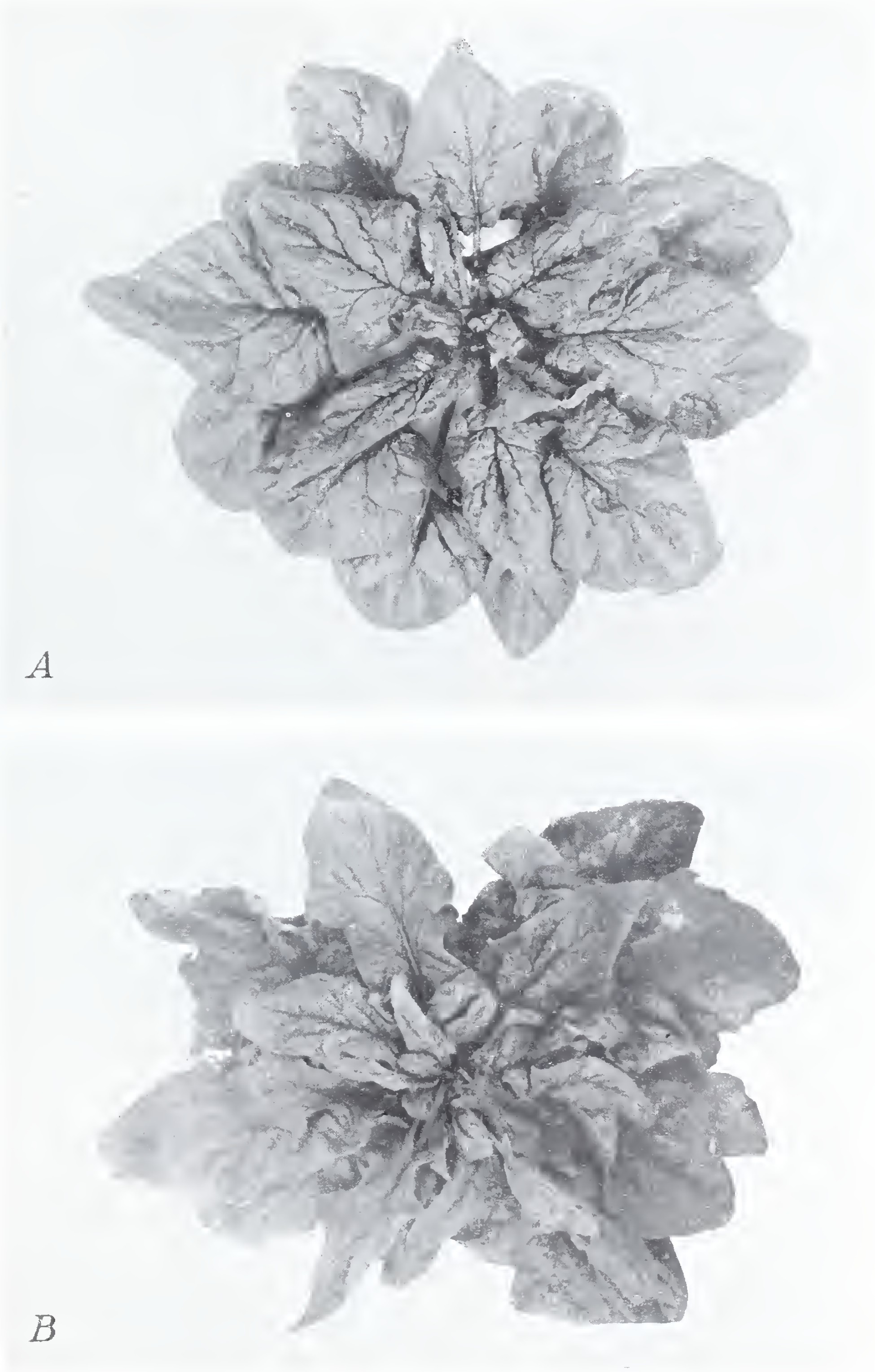
Typical plants of Nobel spinach grown in (A) *New York in 1931,* $\times {}^{1}/_{4.8}$; (B) *Texas in 1932,* $\times {}^{1}/_{4}$. *Note slightly crumpled surface of blades. Compare with plate 17.*

NOBEL SPINACH



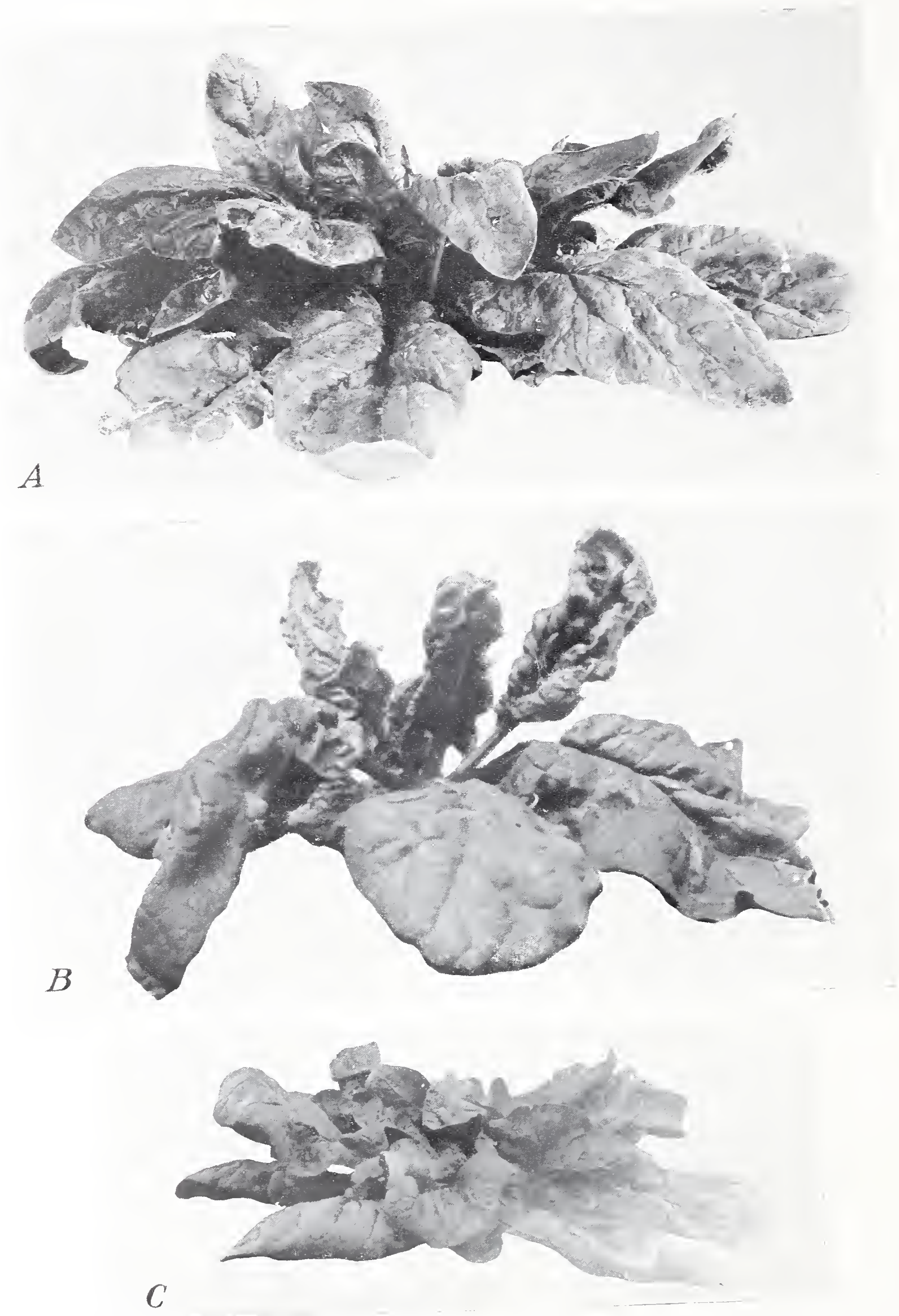
Distorted blades of Nobel spinach due to death of cells along edge of blade caused by desiccating winds in California in (A) *1931 and* (B) *1933. See also plate 21,* B.

NOBEL SPINACH



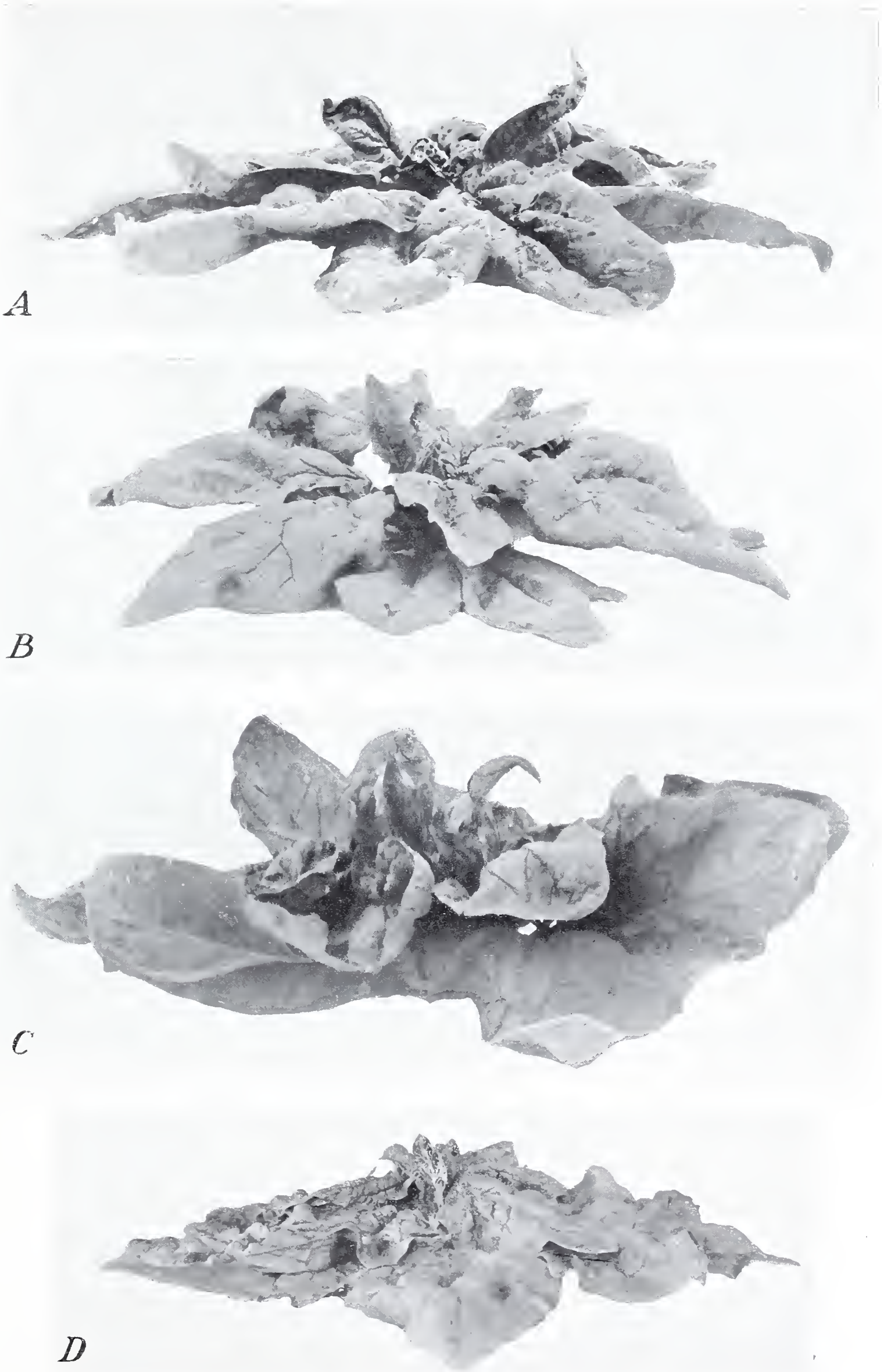
Typical plants of Nobel spinach grown in (A) *Virginia in 1934 and* (B) *California in 1932.* ×1/5. *Note large number of small, spear-shaped leaves in center of* B.

NOBEL SPINACH



Erect center leaves of Nobel spinach as date of seedstalk elongation is approached when grown in (A) *Virginia in 1931,* × 1/5; (B) *California in 1931,* × 1/4; (C) *Texas in 1932,* × 1/3.

NOBEL SPINACH



Flat spreading habit of uncrowded Nobel spinach plants prior to seedstalk elongation when grown in (A) *Virginia in 1931,* × 1/5; (B) *New York in 1932,* × 1/5; (C) *California in 1933,* × 1/4; (D) *Texas in 1931,* × 1/3.

HOLLANDIA

BRIEF CHARACTERIZATION

Grown almost exclusively in California for market and the early canning crop.

Fast growing and produces seedstalks early. Plant large, erect spreading in habit, petioles erect spreading, long, thick with large, light green, almost smooth, very broad hastate blades with blunt-pointed tip and flat margins.

ADAPTABILITY AND USE

Hollandia makes rapid growth and large tonnage for the canneries when grown in the winter in California and is planted for the early canning crop in that State. It is not as winter hardy as Virginia Savoy or Dark Green Bloomsdale and is not recommended for spring sowing because of its early seedstalk formation. Dark-green selections or strains of the same type are rapidly replacing it.

SEASON

Fast growing, reaching 15 cm (6 inches) in diameter in 20 to 30 days from date of germination when grown as a spring-sown crop in the North and East and in 50 to 80 days when sown in the winter in Texas and California. Quick to produce seedstalks, requiring from 25 to 50 days in the North and East and 65 to 115 days in Texas and California from date of germination to appearance of first seedstalks.

PLANT [14]

(Pls. 1, 23, 24, 25, and 26)

Medium size in the North and East as a spring-sown crop, usually 80 to 180 g (2¾ to 6⅓ ounces) in average weight, and large in size as a winter-sown crop in Texas and California, from 160 to 400 g (5½ to 14 ounces) in average weight; average height from 12 to 20 cm (4¾ to 8 inches); average width or spread from 40 to 55 cm (15¾ to 21¾ inches), is approximately 2.7 to 4.7 times the height. Young plants generally erect spreading but tips of older leaves become procumbent, center of plant sometimes open, little axillary growth, except when grown in the winter. Average number of leaves over 1 inch in length usually 15 to 20 but may range under extreme conditions from 12 to 31.

PETIOLE

Slightly lighter green (20 K 6) than blade, long, typically 7 to 13 cm (2¾ to 5 inches) long, 0.55 to 0.85 cm (seven thirty-seconds to eleven thirty-seconds inch) wide, and 10 to 20 times as long as wide, under extremes of environment ranging from 6.4 to 14.0 cm (2½ to 5½ inches) long, 0.56 to 1.21 cm (seven thirty-seconds to one-half inch) wide and 8.4 to 24.7 times as long as wide; slightly curved; round to oval in cross section with a range in ratio of depth to width of 0.89 to 1.21; held at an angle of 15° to 50° with the horizontal.

BLADE

Light green (22 L 5) on upper surface and slightly lighter green (21 K 5) on lower surface; young leaves slightly crumpled or pebbled, with older leaves quite smooth; veins inconspicuous because of similar color; large, typically 12 to 17 cm (4¾ to 6¾ inches) wide, 16 to 22 cm (6¼ to 8½ inches) long, 1.00 to 1.25 times as long as wide, and 1.4 to 2.0 times as long as the petiole; under extremes of environment ranging from 9.9 to 21.9 cm (3⅞ to 8⅝ inches) in average width, 9.7 to 23.6 cm (3¾ to 9¼ inches) in average length, 0.97 to 1.30 times as long as wide, and 1.24 to 2.47 times as long as the petiole. Shape generally broad halberd with one or two shallow, pointed lobes on each side; tip moderately sharp to blunt pointed; base square to slightly cordate; viewed from side, blade convex, from end, slightly concave, flat or convex, depending upon whether margin is concave, flat, or convex.

SEED

Large with moderately long spines or prickles (see fig. 1).

SYNONYMS

Early Prickly Seeded Winter; Giant Broad Leaved Prickly; Herald; Hollandia Giant Leaved Prickly; Ideal; Improved Hollandia; Long Standing Prickly Giant; Prickly Seeded Winter.

SIMILAR VARIETIES

Improved Hollandia, Prickly Winter, and some strains listed as Hollandia are similar but are darker green and slightly later seeding.

HISTORY

Introduced in 1916 by Zwaan and De Wiljes, Scheemda, Netherlands, the result of selection from a monoecious plant of the Valkyria variety. A strain somewhat resistant to blue mold developed from a single plant of Prickly Winter was introduced in 1926 under this name by Zwaan and Van der Molen.

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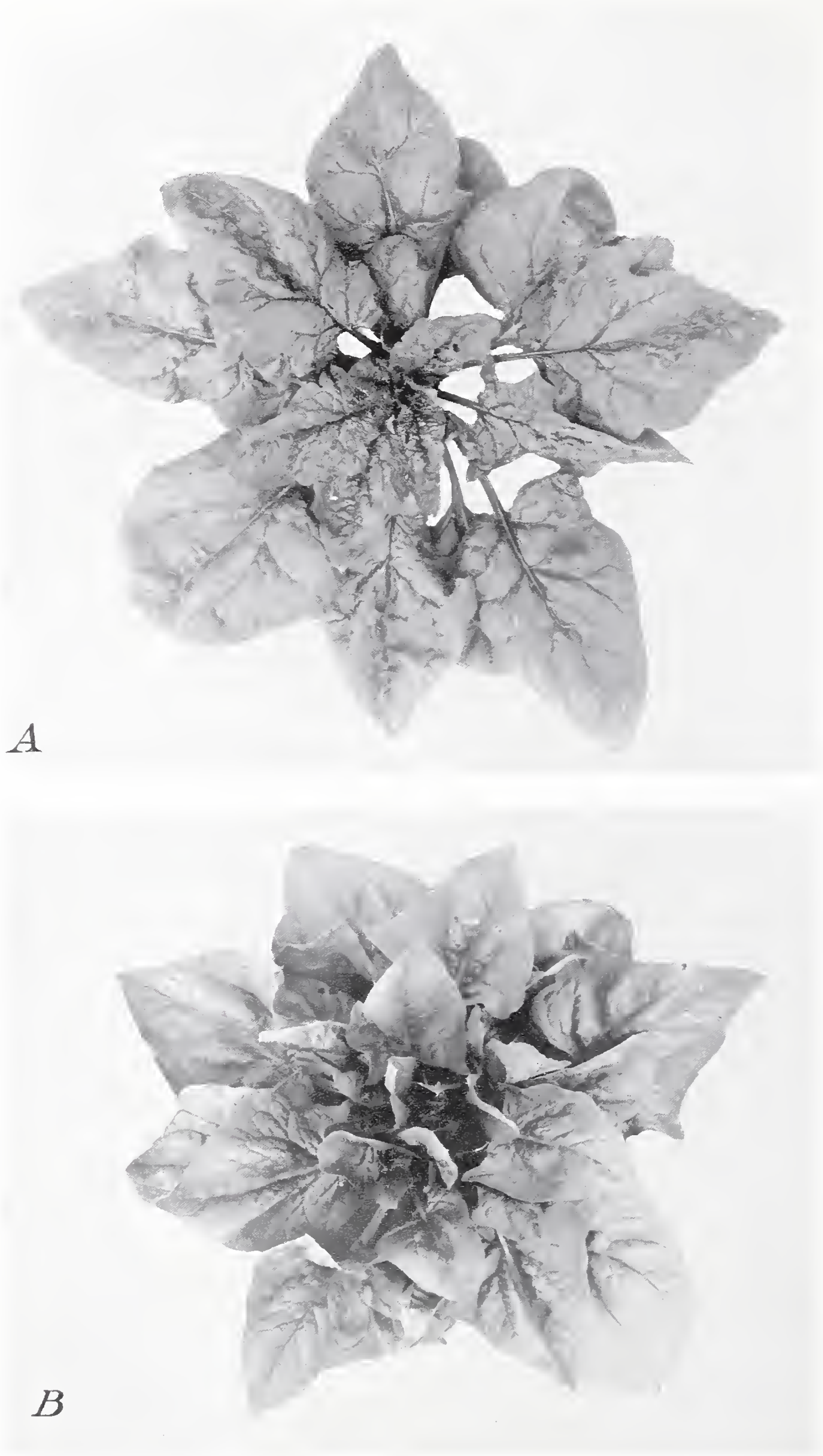
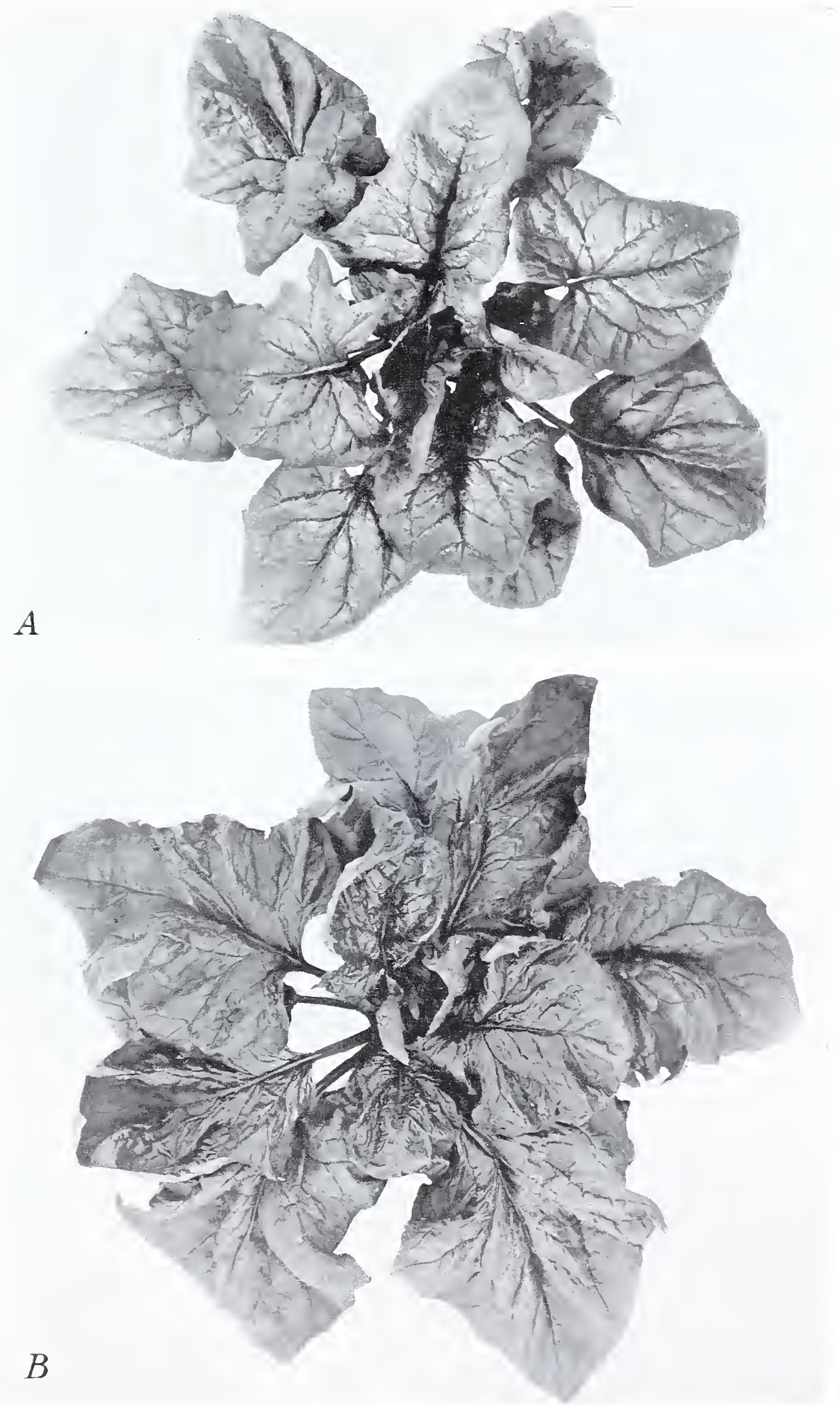
[14] For details of variation in plant characters induced by environment, see tables in Appendix and discussion on p. 5.

HOLLANDIA SPINACH



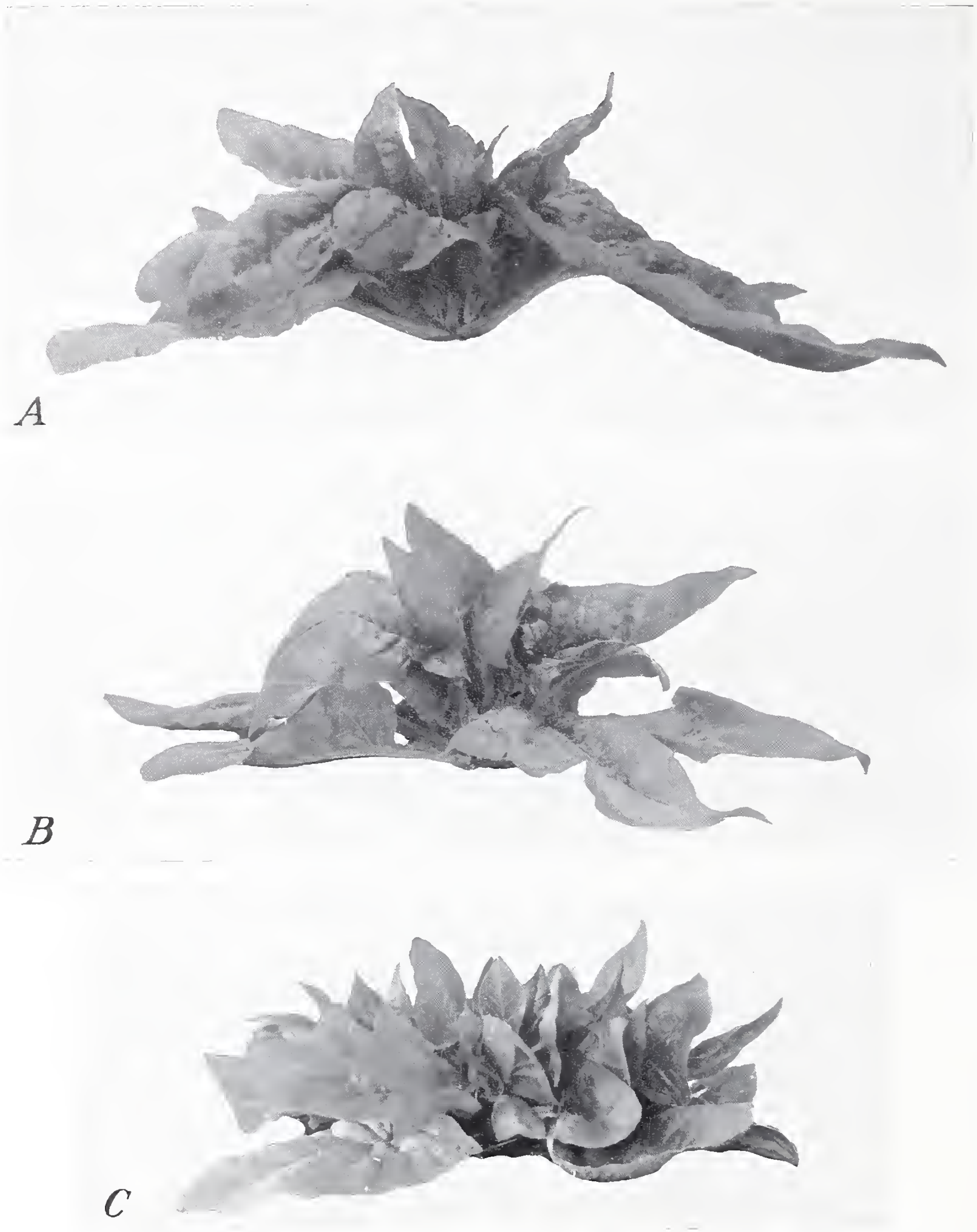
Typical plants of Hollandia spinach grown in (A) *New York in 1932,* × $^{1}/_{4.8}$; (B) *Texas in 1931,* × $^{1}/_{3}$. *Note the flat leaf margins and smooth blades of* B *as compared with plants from other localities.*

HOLLANDIA SPINACH



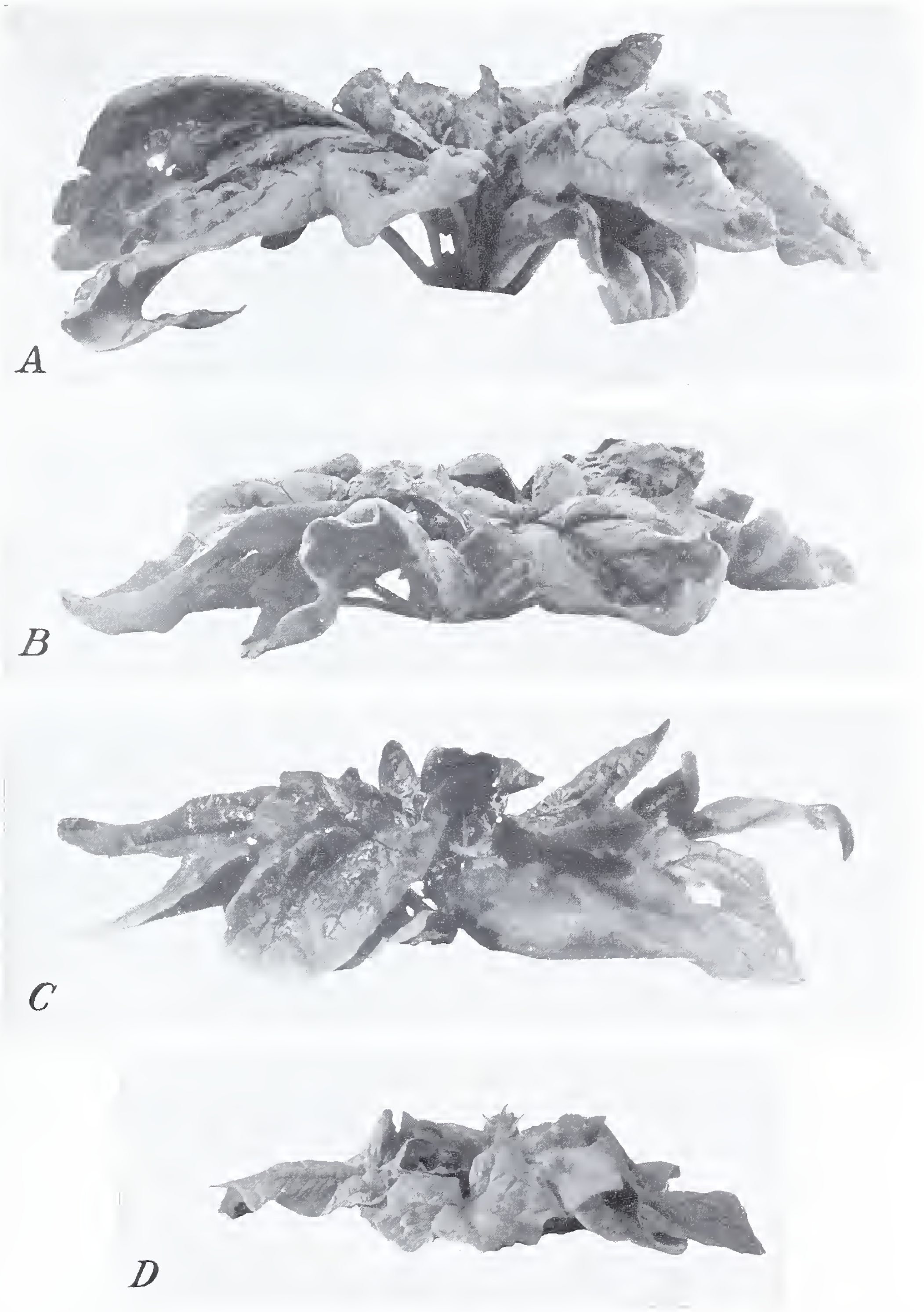
Typical plants of Hollandia spinach grown in (A) *Virginia in 1934 and* (B) *California in 1934.* × 1/5.

HOLLANDIA SPINACH



Erect position of axillary and center leaves of Hollandia spinach as contrasted with spreading habit shown in plate 26. Plants grown in (A) *Virginia in 1932,* × 1/5; (B) *New York in 1931,* × 1/4.8; (C) *Texas in 1931,* × 1/3.

HOLLANDIA SPINACH



Spreading or semiflat habit of Hollandia spinach grown in (A) *Virginia in 1931,* × 1/4; (B) *New York in 1931,* × 1/4.8; (C) *California in 1934,* × 1/5; (D) *Texas in 1931,* × 1/3.

AMSTERDAM GIANT [15]

BRIEF CHARACTERIZATION

Grown almost exclusively in California for the market and as a late canning crop.

Fairly slow growing and fairly slow to produce seedstalks. Plant medium to large, somewhat flattened to slightly spreading in habit; petioles prostrate to slightly ascending, moderately short, thick with large dark-green, almost smooth, slightly oval or halberd-shaped blades with rounded tip and base.

ADAPTABILITY AND USE

Since Amsterdam Giant grows more slowly and stands longer without shooting to seed, it is used to prolong the canning season in certain sections of California. It is also preferred to Hollandia on most of the California markets because of its darker color. It is losing its popularity, however, to the dark-green strains of Hollandia.

SEASON

Slower growing and slower to produce seedstalks than Hollandia.

PLANT

(Pl. 27)

Medium to large size, usually smaller than Hollandia on the same date, but as it stands longer without seedstalks, it may attain the same size. When given plenty of space in which to develop, the plants are quite flat in habit until the seedstalks are formed when the younger leaves become ascending (pl. 27, *A*).

PETIOLE

Generally shorter, slightly darker green, and more nearly horizontal in position than that of Hollandia.

BLADE

Darker green on both upper and lower surfaces than Hollandia. In the Northeastern States the shape is generally elliptical to ovate, but the younger leaves have one shallow blunt-pointed lobe on each side which is sometimes obscured by its curling under; tip is slightly to broadly rounded; base rounded to square and occasionally slightly cordate. In California where the basal lobes and shape of the tip are not obscured by curling under, the blade is generally more nearly halberd- or broad spear-shaped (pl. 27, *C*).

SEED

Medium size with medium length spines or prickles (see fig. 1).

SYNONYMS

Amsterdam Giant Long Standing, Long Standing Prickly Seeded, Long Standing of Enkhuizen Prickly Seeded.

SIMILAR VARIETIES

Amsterdam Giant Improved, Dark Green Prickly, New Giant Thick Leaved Longstanding Prickly, and Standwell are all similar varieties but are slightly later seeding and slightly darker green. Rhineland Giant is similar to Amsterdam Giant Improved but has large round seed instead of prickly seed. Canner King is same type but more resistant to blue mold.

HISTORY

Introduced on the Amsterdam, Netherlands, market over 50 years ago by Sluis en Groot.

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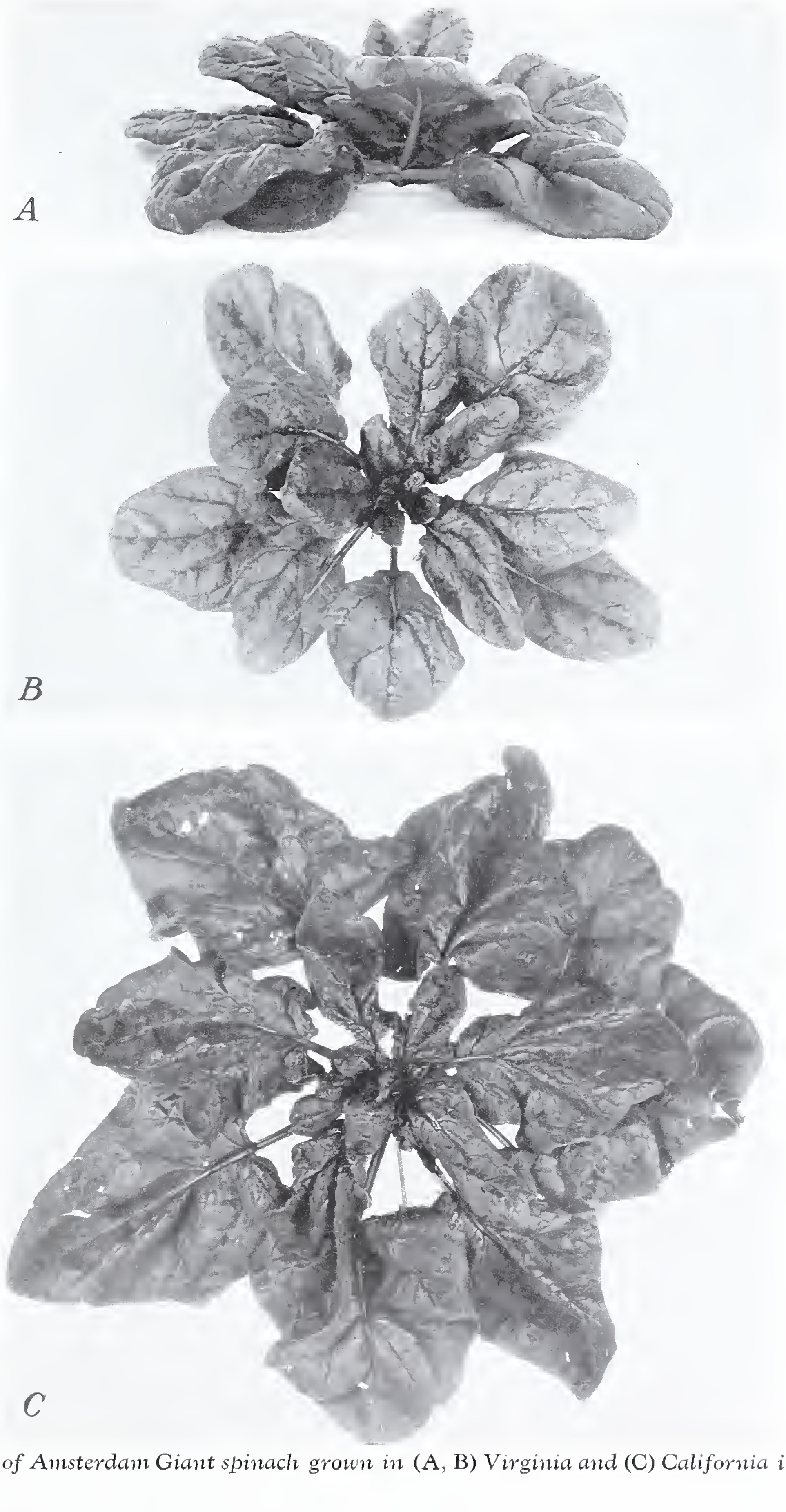
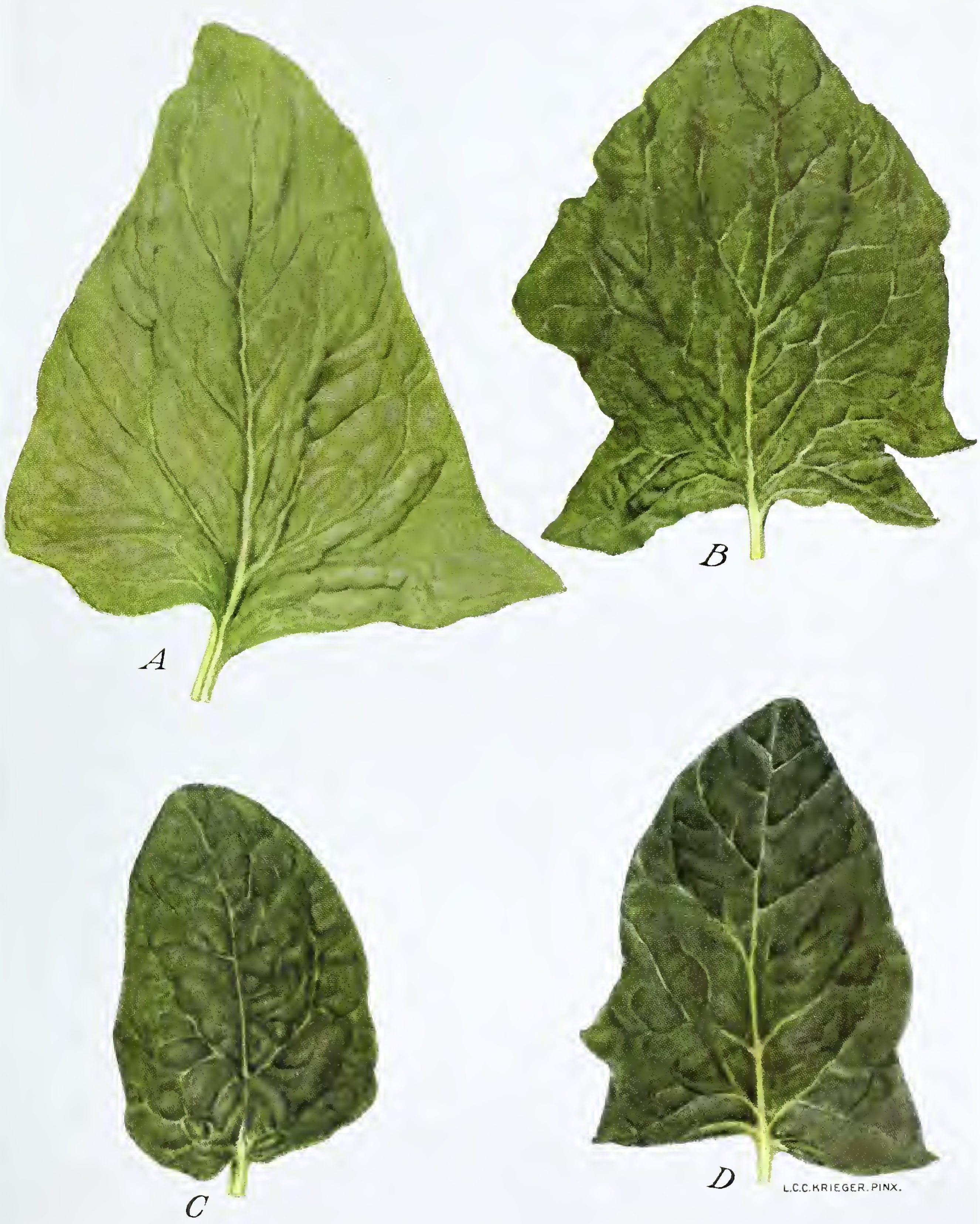
[15] The description of this variety is a comparative one based on observations rather than on actual measurements as with other varieties herein described.

AMSTERDAM GIANT SPINACH



Typical plants of Amsterdam Giant spinach grown in (A, B) *Virginia and* (C) *California in* 1934. × 1/5.



COLOR TYPES OF SPINACH FOLIAGE

A, light green (22L5); *B*, medium green (22K7); *C*, dark green (23L6); *D*, blue green (24L4).

APPENDIX

Table 1.—*Average mean temperatures for 5-day intervals during spinach growing season in 4 localities*

Interval from date of emergence (days)	Average mean temperature when date of emergence was—													
	Ithaca, N. Y.		Arlington, Va.				Davis, Calif.				Winter Haven, Tex.			
	Apr. 20, 1931	May 10, 1932	Apr. 21, 1931	Apr. 1, 1932	May 1, 1933	Apr. 19, 1934	Dec. 24, 1930	Jan. 7, 1931	Dec. 22, 1931	Feb. 8, 1933	Jan. 4, 1931	Jan. 8, 1931	Dec. 14, 1931	Oct. 24, 1932
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1–5	52. 8	55. 2	53. 9	53. 5	64. 9	53. 8	37. 5	43. 1	48. 5	43. 3	52. 7	54. 0	45. 9	64. 3
6–10	40. 8	59. 4	51. 5	51. 6	59. 3	50. 8	44. 4	44. 5	46. 6	44. 5	53. 3	48. 4	53. 4	68. 1
11–15	45. 4	58. 6	55. 8	46. 5	64. 5	56. 4	46. 3	42. 9	45. 5	46. 4	49. 4	50. 6	59. 9	69. 0
16–20	61. 0	65. 4	67. 0	52. 2	67. 3	69. 7	42. 5	49. 8	46. 7	49. 4	50. 9	61. 0	57. 1	57. 8
21–25	58. 2	65. 8	59. 3	60. 0	72. 9	64. 9	44. 3	50. 5	42. 4	50 3	61. 7	61. 2	55. 5	52. 3
26–30	59. 2	64. 0	70. 8	58. 2	73. 5	65. 1	44. 4	54. 3	45. 5	54. 9	62. 3	60. 8	54. 1	58. 5
31–35	55. 2	59. 2	61. 6	62. 3	65. 6	73. 0	50. 3	53. 6	42. 9	52. 3	60. 3	58. 8	66. 1	52. 7
36–40	63. 4	70. 0	71. 4	65. 0	81. 1	59. 9	51. 1	53. 8	45. 6	52. 8	58. 1	59. 4	64. 0	54. 4
41–45	62. 2	70. 0	67. 4	61. 0	72. 1	70. 9	54. 7	49. 9	41. 7	51. 1	59. 9	61. 8	52. 8	65. 2
46–50	63. 6	66. 0	71. 7	64. 5	66. 0	65. 9	53. 3	51. 1	47. 9	53. 2	63. 6	59. 5	56. 8	48. 7
51–55	60. 4	65. 0	71. 3	68. 1		72. 1	53. 0	52. 7	46. 5	59. 5	57. 2	57. 2	62. 8	39. 7
56–60	67. 8	64. 9		69. 9		74. 5	50. 0	55. 3	44. 1	58. 6	56. 2	56. 1	71. 4	51. 1
61–65	69. 6	71. 4		72. 0			51. 8	54. 6	48. 9	56. 6	54. 9	58. 2	68. 3	54. 2
66–70	69. 0						53. 4	54. 7	55. 7	54. 1	61. 4	59. 9	59. 3	49. 8
71–75							54. 9	58. 2	50. 9	58. 0	60. 1	66. 6	57. 6	58. 6
76–80							53. 9	55. 7	55. 6	60. 3	66. 1	63. 5	70. 4	59. 0
81–85							56. 7	55. 4	58. 4	52. 9	61. 0	62. 5	60. 9	54. 3
86–90							57. 5	57. 9	56. 9	54. 1	66. 4	63. 9	42. 6	70. 0
91–95							54. 6	64. 2	55. 3	53. 5	61. 0	63. 9	58. 4	62. 3
96–100							56. 5	57. 9	58. 3	58. 7		68. 5	70. 2	60. 6
101–105							59. 2	69. 1	58. 0	57. 4		67. 6	65. 6	59. 8
106–110							62. 5	61. 0	54. 3	70. 3		68. 2	66. 0	44. 0
111–115									59. 7				72. 6	52. 5
116–120									59. 7				67. 5	58. 2
121–125									52. 2				70. 6	67. 0
126–130									53. 1				77. 6	56. 6
131–135									57. 4					60. 1
136–140														69. 4
141–145														71. 6

Table 2.—*Average daily mean temperature for the growing season of 8 varieties of spinach*

Variety	Ithaca, N. Y.		Arlington, Va.				Davis, Calif .			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1934	1931	1932	1933	1931	1932	1933
	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*
Virginia Savoy	55. 6	61. 8	60. 7	56. 6	63. 4	59. 0	49. 1	49. 0	51. 3	56. 9	59. 4	56. 7
Dark Green Bloomsdale	56. 0	61. 1	61. 4	57. 4	64. 8	60. 9	51. 0	49. 1	52. 0	59. 9	59. 8	57. 2
Long Standing Bloomsdale	56. 0	61. 7	62. 7	59. 4	68. 4	63. 3	50. 8	50. 7	51. 9	60. 4	60. 7	57. 3
Juliana	56. 4	63. 1	63. 2	59. 6	68. 9	63. 3	50. 4	51. 0	52. 4	61. 1		57. 9
King of Denmark	59. 2	63. 9	64. 8	59. 9	69. 9	65. 0	50. 3	51. 0	52. 2	61. 4	61. 4	57. 3
Viroflay	55. 6	61. 1	61. 0	57. 6	65. 4	60. 9	51. 5	50. 6	52. 0	60. 4	58. 8	56. 8
Nobel	56. 4	62. 0	63. 2	58. 0	68. 4	62. 7	51. 5	50. 7	51. 9		61. 4	57. 1
Hollandia	56. 1	61. 1	61. 0	57. 4	67. 5	60. 9	50. 3	50. 0	51. 5	56. 0	58. 8	57. 3

TABLE 3.—*Amount and distribution of rainfall during spinach growing seasons*

Period	Total rainfall	Days having 0.01 inch or more	Distribution
	ITHACA, N. Y.		
	Inches	*Number*	
April 1931	2.48	12	Fair (none 12th–21st).
May 1931	4.48	15	Good.
June 1931	1.75	10	Do.
April 1932	1.36	11	Fair (none 15th–24th).
May 1932	3.46	15	Good.
June 1932	2.97	14	Do.
July 1-11, 1932	1.87	4	Do.
	ARLINGTON, VA.		
April 1931	2.67	8	Good.
May 1931	3.43	10	Do.
June 1-15, 1931	2.21	3	Do.
March 1932	6.91	11	Do.
April 1932	2.88	9	Fair (none 12th–24th).
May 1932	5.11	8	Good.
June 1-3, 1932	.00	0	
April 1933	4.72	10	Good (none 22d-30th).
May 1933	6.72	14	Good.
June 1-19, 1933	2.47	5	Do.
April 1934	3.40	13	Do.
May 1934	4.34	12	Do.
June 1-15, 1934	.71	4	Do.
	DAVIS, CALIF.		
December 1930	0.20	1	Very poor.
January 1931	3.71	9	Good.
February 1931	1.02	9	Do.
March 1931	.85	5	Poor (none 1st–10th).
April 1-6, 1931	0.00	0	
December 1931	7.84	16	Good.
January 1932	1.35	5	Fair (none 3d–14th).
February 1932	1.67	5	Very poor (none 10th–29th).
March 1932	2.01	5	Poor (none 1st–8th, 25th–31st).
April 1932	.66	7	Poor (none 1st–11th).
May 1-3, 1932	.02	1	
February 1933	.66	4	Very poor (none 1st–10th, 17th–28th).
March 1933	1.72	4	Poor (none 1st–11th).
April 1933	.05	1	
May 1-8, 1933	.43	4	Good.
	WINTER HAVEN, TEX.		
December 1930	0.16	4	Very poor (none 5th–20th).
January 1931	5.34	9	Fair (none 1st–8th, 17th–26).
February 1931	.79	10	Good.
March 1931	1.52	4	Very poor (none 1st–14th).
April 1931	4.47	11	Poor (none 1st–12th).
December 1931	3.32	9	Good.
January 1932	.46	8	Do.
February 1932	1.95	8	Fair (none 2d–12th, 22d–29th).
March 1932	.68	4	Very poor (none 6th–31st).
April 1-19, 1932	.00	0	
October 1932	.74	3	Very poor (none 16th–31st).
November 1932	.63	3	Very poor (none 6th–22d).
December 1932	.76	12	Fair (none 1st–8th, 24th–31st).
January 1933	1.62	8	Good (none 1st–5th).
February 1933	3.05	7	Good.
March 1-14, 1933	.27	4	Do.

TABLE 4.—*Approximate hours of possible sunlight (length of day) at dates of first seedstalk appearance and seedling emergence (also shortest day) for 8 varieties of spinach grown in four localities*

[Day length at date of first seedstalks]

Variety	Ithaca, N. Y.		Arlington, Va.				Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1934	1931	1932	1933	1931	1932	1933
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
Virginia Savoy	15.1	15.2	14.7	14.3	14.4	14.2	11.9	12.5	13.0	[1] 11.9	11.6	10.5
Dark Green Bloomsdale	15.1	15.2	14.7	14.4	14.5	14.5	[2] 10.8	12.5	13.3	12.4	11.8	10.6
Long Standing Bloomsdale	15.1	15.2	14.8	14.7	14.8	14.8	12.8	13.7	13.7	12.9	12.8	11.7
Juliana	15.2	15.2	14.9	14.7	14.9	14.8	12.6	13.8	14.1	13.1		12.0
King of Denmark	15.2	[3] 15.0	14.9	14.7	14.9	14.9	12.6	13.8	13.7	13.2	13.0	11.7
Viroflay	15.1	15.2	14.7	14.4	14.6	14.4	[2] 11.1	13.5	13.3	12.9	12.0	11.2
Nobel	15.2	15.2	14.9	14.5	14.8	14.8	[2] 11.0	13.6	13.6	(1)	13.0	11.5
Hollandia	15.2	15.2	14.7	14.4	14.6	14.4	12.5	13.1	13.1	[1] 12.7	12.0	10.7
[Day length at emergence (also for shortest day)]												
	13.6	14.4	13.4	12.6	13.8	13.3	9.4	9.4	10.4	10.4	10.3	[4] 11.2

[1] Day length at emergence, 10.3 hours.
[2] Day length at emergence, 9.6 hours.
[3] Longest day during growth period, 15.2 hours.
[4] Shortest day during growth period, 10.3 hours.

TABLE 5.—*Influence of temperature and rainfall on speed of germination of spinach seed*

Location	Days to germinate	Germination period	Average air temperature			Rainfall		Days—		
			Mean	Minimum	Maximum	Days over 0.01 inch	Total	Clear	Partly clear	Cloudy
	Number		° *F.*	° *F.*	° *F.*	*Number*	*Inches*	*Number*	*Number*	*Number*
Ithaca, N. Y.	11	Apr. 9-19, 1931	50.8	36.4	64.5	1	0.44	7	2	2
	17	Apr. 23-May 9, 1932	49.7	40.1	58.2	9	2.39	2	5	10
Arlington, Va.	7	Apr. 14-20, 1931	59.8	43.0	76.5	1	.13	6	1	0
	29	Mar. 3-31, 1932	42.3	33.1	51.5	12	6.91	11	9	9
	7	Apr. 24-30, 1933	59.1	46.5	73.0	0	.00	5	2	0
	10	Apr. 9-18, 1934	52.0	41.1	61.2	4	1.93	3	6	1
Davis, Calif.	15	Dec. 9-23, 1930	45.4	32.7	59.4	1	.20	11	1	3
	11	Dec. 27, 1930-Jan. 6, 1931	43.9	32.0	55.7	3	2.40	5	1	5
	10	Dec. 12-21, 1931	42.7	33.9	51.6	4	1.71	6	3	1
	27	Jan. 12-Feb. 7, 1933	41.8	31.5	52.5	11	3.67	10	4	13
Winter Haven, Tex.	12	Dec. 23, 1930-Jan. 3, 1931	49.2	38.7	59.8	2	.05	2	6	4
	10	Dec. 29, 1930-Jan. 7, 1931	50.6	37.3	63.9	1	.03	3	4	3
	11	Dec. 3-13, 1931	58.0	47.7	68.3	5	2.84	4	3	4
	6	Oct. 18-23, 1932	73.6	60.5	86.7	0	.00	4	1	1

TABLE 6.—*Ratio of plant spread to plant height at prime marketable stage of maturity of 8 varieties of spinach*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
Virginia Savoy	2.09	2.24	2.39	2.26	1.72	1.81	2.31	2.16	3.91	2.05	2.20
Dark Green Bloomsdale	2.01	1.82	2.31	2.47	1.60	1.75	2.38	2.22	3.68	2.21	2.08
Long Standing Bloomsdale	2.04	2.34	2.64	2.25	1.86	2.02	2.56	2.29	4.29	3.91	2.66
Juliana	2.31	2.46	3.61	3.12	3.03	2.31	2.49	2.34	4.02	4.22	3.36
King of Denmark	4.60	2.60	5.06	4.61	2.40	3.40	3.17	3.70	11.43	6.37	3.87
Viroflay	2.55	3.63	4.79	3.27	2.71	2.94	3.35	3.71	9.48	5.31	4.15
Nobel	3.38	4.43	5.14	3.06	2.52	3.05	3.14	2.95	9.08	6.10	3.86
Hollandia	3.09	3.03	4.00	3.46	------	2.63	2.79	2.63	5.97	4.71	3.47

TABLE 7.—*Number of days between seedling emergence and appearance of first seedstalk on 8 varieties of spinach grown in 4 localities*

Variety	Days between emergence and appearance of first seedstalk when emergence was—											
	Ithaca, N. Y.		Arlington, Va.				Davis, Calif.			Winter Haven, Tex.		
	Apr. 20, 1931	May 10, 1931	Apr. 21, 1931	Apr. 1, 1932	May 1, 1933	Apr. 19, 1934	Dec. 24, 1930	Dec. 22, 1931	Feb. 8, 1933	Jan. 8, 1931	Dec. 14, 1931	Oct. 24, 1932
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Virginia Savoy	46	29	38	45	19	24	81	98	61	[1] 67	78	87
Dark Green Bloomsdale	48	35	40	48	23	32	[2] 72	99	69	79	85	92
Long Standing Bloomsdale	48	38	47	58	39	47	103	127	78	97	119	131
Juliana	54	45	52	59	49	47	100	132	89	107	------	141
King of Denmark	70	62	55	62	43	57	97	133	80	111	127	132
Viroflay	46	34	39	49	24	32	[2] 80	123	69	97	95	114
Nobel	54	39	52	53	39	45	[2] 77	126	77	(1)	127	124
Hollandia	49	35	39	48	27	32	94	112	64	[1] 94	95	96

[1] Emerged Jan. 4, 1931.

[2] Emerged Jan. 7, 1931.

TABLE 8.—*Average plant weight at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Virginia Savoy	43.9	82.1	62.3	72.2	7.0	78.1	61.2	142.7	30.9	111.4	128.5
Dark Green Bloomsdale	121.5	104.6	54.8	93.2	24.6	99.3	93.3	193.5	57.5	140.0	137.1
Long Standing Bloomsdale	96.4	165.4	169.9	168.0	43.6	98.5	120.6	174.9	67.1	189.2	139.0
Juliana	84.8	138.6	111.8	123.3	34.4	74.4	89.2	136.2	56.9	124.0	73.4
King of Denmark	79.6	299.8	260.3	215.4	67.5	146.8	102.5	296.9	47.0	109.9	378.1
Viroflay	53.1	104.0	127.5	148.6	29.5	213.6	122.6	307.4	70.7	180.2	392.2
Nobel	146.7	119.4	408.2	260.1	88.8	223.9	215.1	410.5	73.7	199.5	323.7
Hollandia	127.9	79.0	182.9	145.5	------	173.9	159.4	329.7	53.1	263.6	396.7

TABLE 9.—*Average plant spread at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Cm	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
Virginia Savoy	26.3	33.9	28.7	27.9	17.2	24.3	28.6	32.8	22.8	33.7	26.8
Dark Green Bloomsdale	30.6	30.8	22.9	28.5	20.5	22.0	26.4	33.4	25.2	31.0	25.5
Long Standing Bloomsdale	25.8	30.9	30.6	31.1	20.8	19.9	23.6	27.7	24.7	34.7	26.8
Juliana	23.7	29.0	27.1	26.6	19.9	19.5	20.3	22.5	19.4	28.7	23.0
King of Denmark	41.2	54.1	64.0	55.6	38.0	47.8	33.9	49.0	31.1	47.1	54.0
Viroflay	34.9	44.7	48.4	53.4	33.4	54.7	44.7	55.7	37.3	53.1	55.0
Nobel	48.3	47.1	72.4	57.0	39.3	50.8	47.8	54.0	32.7	51.2	48.8
Hollandia	47.3	37.3	51.2	44.5	------	50.5	46.0	54.2	31.6	60.3	53.1

TABLE 10.—*Average plant height at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Cm	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
Virginia Savoy	12.6	15.1	11.9	12.3	9.9	13.4	12.4	15.2	5.8	16.4	12.2
Dark Green Bloomsdale	15.2	16.8	9.9	11.5	12.8	12.5	11.1	15.0	6.8	14.0	12.2
Long Standing Bloomsdale	12.6	13.2	11.6	13.8	11.2	9.8	9.2	12.1	5.8	8.9	10.1
Juliana	10.3	11.8	7.5	8.5	6.6	8.4	8.2	9.6	5.2	6.8	6.8
King of Denmark	8.9	20.8	12.6	12.0	15.8	14.0	10.7	13.2	2.7	7.4	13.9
Viroflay	13.7	12.3	10.1	16.3	12.3	18.6	13.3	15.0	3.9	10.0	13.3
Nobel	14.3	10.6	14.0	18.6	15.6	16.6	15.2	18.3	3.6	8.5	12.6
Hollandia	15.2	12.3	12.8	12.8	------	19.2	16.5	20.6	5.3	12.8	17.1

Table 11.—*Average number of leaves over 1 inch in length at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Virginia Savoy	14. 5	16. 9	17. 6	15. 5	8. 7	13. 8	13. 3	11. 4	[1] 12. 6	18. 0	28. 8
Dark Green Bloomsdale	17. 4	16. 4	14. 0	15. 6	13. 6	[2] 16. 0	13. 6	14. 5	12. 5	19. 0	30. 2
Long Standing Bloomsdale	15. 5	16. 3	25. 8	22. 1	21. 9	19. 7	21. 0	16. 3	13. 8	25. 4	29. 0
Juliana	15. 5	16. 9	23. 4	18. 7	19. 6	18. 4	17. 0	16. 3	12. 0	23. 7	24. 4
King of Denmark	15. 0	25. 6	30. 2	23. 4	22. 4	17. 9	19. 1	17. 5	11. 9	17. 7	41. 1
Viroflay	16. 7	18. 0	22. 4	19. 1	15. 8	[2] 16. 3	16. 0	16. 1	15. 0	21. 9	38. 7
Nobel	18. 5	21. 9	37. 3	22. 9	26. 0	[2] 18. 9	17. 8	18. 3	[1] 15. 7	22. 2	38. 4
Hollandia	20. 2	17. 4	20. 5	16. 6	----------	14. 7	16. 1	11. 9	[1] 12. 3	21. 7	31. 5

[1] Seedlings emerged 4 days earlier than other varieties due to earlier planting.

[2] Seedlings emerged 14 days later than other varieties due to later planting.

Table 12.—*Average blade length of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Cm	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
Virginia Savoy	9. 1	13. 0	15. 2	12. 6	7. 4	8. 4	10. 6	14. 0	7. 3	11. 4	10. 2
Dark Green Bloomsdale	14. 1	13. 1	13. 2	13. 3	9. 3	9. 4	11. 6	13. 2	8. 4	10. 4	10. 1
Long Standing Bloomsdale	13. 6	13. 3	17. 6	14. 2	8. 5	9. 2	9. 7	12. 2	8. 8	12. 2	9. 4
Juliana	11. 5	11. 3	14. 7	10. 6	7. 8	8. 0	8. 2	9. 7	7. 5	9. 8	8. 1
King of Denmark	16. 2	20. 0	27. 9	19. 5	13. 6	16. 0	11. 1	19. 6	9. 8	14. 6	17. 5
Viroflay	14. 4	16. 3	21. 0	21. 4	13. 0	20. 3	15. 5	21. 5	11. 0	17. 7	19. 4
Nobel	20. 8	16. 2	32. 7	22. 5	15. 7	18. 8	17. 4	22. 9	9. 6	17. 8	17. 6
Hollandia	21. 0	13. 8	23. 6	18. 5	----------	17. 7	16. 0	23. 0	9. 7	18. 9	17. 1

Table 13.—*Average blade width of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Cm	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
Virginia Savoy	6. 7	10. 8	11. 3	10. 8	4. 9	6. 9	8. 8	12. 2	6. 9	10. 5	9. 1
Dark Green Bloomsdale	14. 1	12. 4	10. 4	12. 3	7. 4	8. 6	10. 3	12. 3	8. 2	10. 2	8. 9
Long Standing Bloomsdale	12. 9	11. 9	13. 3	13. 3	7. 2	9. 5	9. 0	11. 4	7. 9	10. 6	8. 4
Juliana	9. 1	9. 6	9. 7	10. 9	5. 7	8. 5	7. 3	9. 9	7. 4	8. 5	7. 1
King of Denmark	12. 0	14. 5	16. 0	15. 7	8. 4	14. 7	9. 5	16. 0	9. 3	10. 8	13. 8
Viroflay	12. 3	12. 2	12. 5	15. 9	8. 9	17. 0	13. 1	18. 5	9. 4	13. 6	15. 1
Nobel	16. 7	12. 4	20. 9	18. 2	11. 2	15. 4	13. 9	17. 8	8. 7	13. 8	11. 9
Hollandia	16. 1	10. 9	18. 7	15. 5	----------	18. 0	14. 9	21. 9	9. 9	15. 8	14. 7

Table 14.—*Average ratio of blade length to blade width of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
Virginia Savoy	1. 19	1. 20	1. 34	1. 16	1. 50	1. 02	1. 20	1. 15	1. 05	1. 08	1. 12
Dark Green Bloomsdale	1. 00	1. 06	1. 34	1. 08	1. 25	1. 09	1. 12	1. 07	1. 01	1. 01	1. 14
Long Standing Bloomsdale	1. 04	1. 12	1. 32	1. 06	1. 17	. 96	1. 08	1. 07	1. 10	1. 15	1. 12
Juliana	1. 15	1. 17	1. 52	. 97	1. 37	. 94	1. 12	. 98	1. 02	1. 16	1. 14
King of Denmark	1. 35	1. 39	1. 74	1. 24	1. 63	1. 08	1. 16	1. 22	1. 06	1. 35	1. 27
Viroflay	1. 16	1. 34	1. 68	1. 34	1. 46	1. 19	1. 18	1. 16	1. 17	1. 30	1. 28
Nobel	1. 24	1. 30	1. 56	1. 23	1. 40	1. 22	1. 25	1. 29	1. 10	1. 28	1. 47
Hollandia	1. 30	1. 26	1. 26	1. 18	----------	. 98	1. 06	1. 05	. 97	1. 19	1. 16

Table 15.—*Average ratio of blade length to petiole length of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
Virginia Savoy	1. 55	1. 47	1. 90	1. 65	1. 36	1. 25	1. 25	1. 33	1. 77	1. 14	1. 35
Dark Green Bloomsdale	1. 46	1. 47	1. 90	1. 75	1. 25	1. 50	1. 61	1. 67	1. 82	1. 18	1. 41
Long Standing Bloomsdale	1. 73	1. 72	2. 23	1. 89	1. 39	1. 76	2. 01	2. 03	1. 93	1. 55	1. 40
Juliana	1. 84	1. 80	2. 94	2. 07	1. 99	1. 94	2. 08	2. 15	2. 02	1. 81	1. 78
King of Denmark	1. 86	1. 66	2. 28	1. 76	1. 52	1. 48	1. 50	2. 20	1. 48	1. 48	1. 35
Viroflay	1. 87	1. 85	1. 99	2. 14	1. 47	1. 59	1. 60	1. 99	1. 40	1. 66	1. 50
Nobel	1. 24	2. 02	2. 85	2. 48	1. 97	1. 87	2. 09	2. 73	1. 10	2. 06	1. 89
Hollandia	1. 72	1. 88	2. 06	2. 47	----------	1. 48	1. 56	1. 96	1. 52	1. 34	1. 24

TABLE 16.—*Average petiole length of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.		Arlington, Va.			Davis, Calif.			Winter Haven, Tex.		
	1931	1932	1931	1932	1933	1931	1932	1933	1931	1932	1933
	Cm	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
Virginia Savoy	6.1	8.8	8.0	7.6	5.5	5.7	8.5	10.5	4.1	10.0	7.6
Dark Green Bloomsdale	9.6	8.9	6.8	7.6	7.5	6.3	7.2	7.9	4.6	8.8	7.2
Long Standing Bloomsdale	7.8	7.7	7.9	7.5	6.1	5.2	4.8	6.0	4.5	7.8	6.7
Juliana	6.2	6.2	5.0	5.1	3.9	4.1	3.9	4.5	3.7	5.1	4.5
King of Denmark	8.7	12.1	12.2	11.1	8.9	10.8	7.4	8.9	6.6	9.8	13.0
Viroflay	7.7	8.8	10.5	10.0	8.8	12.7	9.7	10.8	7.9	10.6	13.0
Nobel	8.8	8.0	11.5	9.1	7.9	10.1	8.3	8.4	6.2	8.6	9.3
Hollandia	7.7	7.3	11.5	7.5	----------	12.0	10.2	11.7	6.4	14.0	13.8

TABLE 17.—*Average petiole diameter of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.	Arlington, Va.			Davis, Calif.		Winter Haven, Tex.	
	1932	1931	1932	1933	1932	1933	1932	1933
	Cm	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
Virginia Savoy	0.62	0.62	0.68	0.30	0.61	1.01	0.58	0.48
Dark Green Bloomsdale	.71	.63	.75	.44	.69	.92	.60	.53
Long Standing Bloomsdale	.77	.74	.85	.42	.60	.81	.64	.52
Juliana	.76	.72	.86	.45	.57	.73	.56	.48
King of Denmark	.75	.77	.74	.47	.46	.76	.54	.56
Viroflay	.59	.61	.76	.41	.57	1.00	.56	.53
Nobel	.68	.88	.99	.46	.71	1.08	.59	.61
Hollandia	.58	.74	.89	----------	.69	1.21	.69	.56

TABLE 18.—*Average ratio of petiole length to petiole diameter of largest leaf at prime marketable stage of maturity of 8 varieties of spinach grown in 4 localities*

Variety	Ithaca, N. Y.	Arlington, Va.			Davis, Calif.		Winter Haven, Tex.	
	1932	1931	1932	1933	1932	1933	1932	1933
Virginia Savoy	14.1	12.9	11.7	18.3	13.9	10.4	17.2	15.9
Dark Green Bloomsdale	12.4	10.7	10.8	16.9	10.3	8.6	14.6	13.6
Long Standing Bloomsdale	10.7	10.6	8.9	14.4	8.0	7.4	12.2	12.7
Juliana	8.2	6.8	5.9	8.7	6.8	6.2	9.7	9.4
King of Denmark	16.1	16.0	14.8	18.9	16.0	11.7	18.1	23.2
Viroflay	14.9	17.3	13.0	21.7	17.0	10.8	18.8	24.3
Nobel	11.8	13.0	9.2	17.4	11.7	7.8	14.5	15.2
Hollandia	12.5	15.5	8.4	----------	14.7	9.7	20.1	24.7

TABLE 19.—*Percentage of diseased plants in 9 varieties of spinach grown during the fall and winter of 1932–33 at Arlington, Va., Ithaca, N. Y., and Winter Haven, Tex.*

Variety	Arlington, Va.			Ithaca, N. Y.			Winter Haven, Tex.			
									Plants diseased	
	Strains	Plants	Plants diseased	Strains	Plants	Plants diseased	Strains	Plants	Fusarium wilt	Virus diseases
	Number	*Number*	*Percent*	*Number*	*Number*	*Percent*	*Number*	*Number*	*Percent*	*Percent*
Virginia Savoy	3	698	2.2	2	207	2.4	2	335	23.6	5.4
Old Dominion	----------	----------	----------	1	19	5.4	----------	----------	----------	----------
Dark Green Bloomsdale	4	931	10.7	3	280	55.7	3	575	17.7	6.3
Long Standing Bloomsdale	4	932	27.0	3	289	66.9	3	584	16.5	5.3
Juliana	3	638	15.2	2	179	32.5	2	435	20.1	2.5
King of Denmark	4	499	30.8	3	192	66.4	3	546	19.2	15.5
Viroflay	3	380	27.7	2	194	50.0	2	256	29.9	15.2
Nobel	4	523	42.7	3	306	66.4	3	468	29.1	12.4
Hollandia	4	504	52.8	4	374	44.9	4	471	24.1	12.6

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U. S. GOVERNMENT PRINTING OFFICE: 1938